SERVITIZATION STRATEGIES & FIRM BOUNDARY DECISIONS

by

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In loving memory of
Robert (Bob) Johnston
A true mentor and friend.

Declaration of own work

I hereby declare that this thesis, titled:

Servitization Strategies & Firm Boundary Decisions

and submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy in Industrial and Business Studies at The University of Warwick, presents my own work and has not been previously submitted to this or any other institution for any degree, diploma or other qualification. All sources of quoted information are acknowledged by means of references.

Emmanouil Alvizos

Abstract

This PhD thesis focuses on a particular manifestation of the servitization of manufacturing phenomenon, namely the offering of advanced asset management services for mature capital equipment in a business to business context. In contrast to past research in the field, the study approaches the issue from the often neglected point of view of the offerings' intended customers and assumes a strategic perspective to shed light on the considerations that affect the customers' propensity to accept or reject them.

Upon conceptually analysing what the acceptance of such offerings actually requires of customers at an operational level, the study reveals that the latter are in most cases required to outsource a number of activities that have traditionally been handled in-house. Thus, the issue of accepting servitized offerings of this nature is treated as a make-or-buy, or otherwise a firm boundary decision dilemma on behalf of customers.

In adopting this treatment, the study then engages with the firm boundary/outsourcing literature and considers the state-of-the–art in four contemporary theoretical frameworks of make-or-buy decisions that reflect a customer firm's efficiency, dependence, competence and identity related strategic considerations. In particular, insights are drawn respectively from Transaction Cost Economics, Resource Dependency Theory, a strand of the Resource-Based View of the firm as well as the tenet of Identity Coherence.

Augmented with a number of novel propositions, the collective body of considerations is then empirically explored through a quasi-experimental cross-sectional survey of deep-sea dry and wet cargo shipping firms (considered as customers of servitization) that focuses on six key maintenance activities related to a ship's main propulsion engine (considered as the object of servitization).

In performing a two tier statistical analysis of the empirical data through logistic and multiple regression techniques, the study finds that alternative considerations affect a customer firm's decision of whether to outsource an activity or not and the decision of how much of an activity to outsource once the first-tier dilemma is answered positively. Furthermore, the study finds that combined theoretical perspective approaches offer better explanations of the phenomenon in question.

With its conclusion, the thesis offers a number of implications directed at the literature streams involved as well as the practice of outsourcing and pursuing a servitization strategy.

Abbreviations

Bhp	-	Brake-horse power
C&C	-	Command & Control
CEO	-	Chief Executive Officer
CI	-	Confidence Interval
C-OAR-SE	-	Construct definition, Object and Attribute classification, Rater identification, Scale formation and Enumeration
CSV	-	Comma Separated Values
DCT	-	Dynamic Capabilities Theory
DWT	-	Dead Weight Tonnage or deadweight tonnage
ET	-	Embeddedness Theory
EU	-	European Union
FPC	-	Finite Population Correction
IMO	-	International Maritime Organization
INTERCARGO	-	International Association of Dry Cargo Ship-owners
INTERTANKO	-	International Association of Independent Tanker Owners
K-S	-	Kolmogorov - Smirnov
MAR	-	Missing At Random
MCAR	-	Missing Completely At Random
MNAR	-	Missing Not At Random
OIC	-	Organizational Identity Coherence
PBL	-	Performance-Based Logistics
PRL	-	Proportional Reduction in Loss
RBV	-	Resource-Based View (of the firm)
RDT	-	Resource Dependency Theory
ROT	-	Real Options Theory
S-W	-	Shapiro-Wilk
SPSS	-	Statistical Package for the Social Sciences
TCE	-	Transaction Cost Economics
WTP	-	Willingness To Pay

Chapter 1

Introduction

1.1 Research overview

This research focuses on a particular type of the servitization of manufacturing phenomenon, labeled as transactional servitization. In the broadest of terms, the servitization of manufacturing phenomenon represents a series of strategies employed by manufacturers to better position themselves in a given value chain, so as to capture more value or somehow enhance their revenue streams through services. The phenomenon, invariably manifested within industrial business-to-business contexts, is more pronounced in mature industries involving capital equipment with long life-cycles. A key reason behind this is that, the longevity of the equipment involved eventually leads to large installed-bases, which in-turn lead to saturated markets that hinder a manufacturer's future growth potential. As such, the traditional box-pushing model may quickly prove to be unsustainable, thus, leading to the pursuit of alternative or complementary sources of growth. Enter servitization, or the pursuit of further growth through services.

A literature review of the phenomenon reveals that servitization offers two discrete ways by which a manufacturer may 'servitize' to achieve further growth. The first relates to the manufacturer attempting to enhance or diversify its portfolio of offerings by providing an assortment of additional services along with its existing goods. This means that the manufacturer complements the box-pushing model with the offering of ancillary services that may be purchased in addition to the good itself. Most often, however, these services which commonly include consultancy, maintenance and training are already available from third-party suppliers and it is up to the customer to choose which ones to buy. To remedy this, a manufacturing firm may either pursue the same strategy in different business ecologies or it may pursue an alternative servitization mode. Thus, the second way to 'servitize' relates to the manufacturer attempting to altogether change the way that the functionality of its products is offered to the customers. In this second type of servitization, the manufacturer does not seek to offer services on top of the goods, but rather attempts to offer the end result of the good itself as a 'total' service to the industrial customer. In this case, once a customer accepts such an offering, the separate provision or choice of any additional services becomes irrelevant as everything is included in the 'total' service. It is this second type of servitization, labeled as transactional servitization that is the focus of this research.

Archetypically, transactional servitization has been identified with the offering of so-called performance-based contracts and is best known through Rolls-Royce's 'power-by-the-hour' offering for aircraft engines. Through that offering, instead of once and for all selling the engine, the maker seeks to charge airline companies on an engine thrust output basis over each flight-hour logged by an airplane. Variations of this model may include arrangements where the customer 'leases' the capital equipment's functionality on a calendar time basis or some other relevant metric representing usage or output. The corollary of such revenue models, however, is that the customer firm is asked to hand over the management of all maintenance and any other auxiliary operations exclusively to the manufacturer's care while essentially purchasing the functionality of the capital equipment (engine) on a usage regime. The rationale behind the strategy is that it enables the manufacturer to automatically capture any value from 'downstream' after-sales activities (e.g. consultancy, maintenance and training) and to lock the customer firm in a continuous relationship that additionally yields relatively more stable revenue streams.

While the model's appeal to the manufacturer seeking further growth may be obvious, this study contests that the model's appeal to the customer firm is strikingly ambiguous. That is to say that while the manufacturer has a lot of strategic reasons to try and transactionally servitize its offerings, why would the customer firm want to be locked up in a continuous relationship? Why would it want to give up on its existing technical competences and hand over all operations to the manufacturer? Previous research on servitization is markedly silent on this point having primarily focused on the manufacturer's point of view. Past studies have predominantly been occupied with the operational ways with which manufacturers may make their way towards transactionally servitized offerings all the while assuming that the demand for such offerings is a given fact. As such, a research gap is identified in the study of servitization from the customer firm's strategic point of view.

Having identified this research gap, the study adopts a strategic management perspective towards the study of transactional servitization, and attempts to uncover the conditions under which the strategy is more or less likely to be received positively by its target audience. In other words, the study seeks to identify the strategic conditions under which the potential customers of transactionally servitized offerings are more or less likely to accept them. As such, the initial question guiding the study asked 'Which strategic considerations influence a customer firm's decision to accept or reject transactionally servitized offerings against traditional product offerings?'.

To facilitate the uncovering of these conditions, the study examines what the acceptance of such offerings actually means for the customer firm. Upon comparing traditional product offerings with transactionally servitized offerings, the study finds that the latter require customer firms to outsource a particular set of activities that were traditionally handled by them. In the case of airline companies, for example, accepting the 'power-by-the-hour' model means that the customer airline is required to outsource the management of all maintenance activities to Rolls-Royce. In other words, it is found that the decision to accept or reject such offerings poses a make-or-buy or firm boundary decision problem to the customer firm with regard to the activities targeted by the offerings. Given this premise, the acceptance of servitized offerings is equated with the willingness (or propensity) to outsource said activities. As a result, the initial research question is narrowed down to the following:

RQ: Which strategic considerations influence a customer firm's decision to outsource or not activities targeted by transactionally servitized offerings?

Having identified that the acceptance or rejection of transactionally servitized offerings depends on the customer firm's insourcing or outsourcing preferences over a particular set of activities, the study is further informed by the outsourcing/make-or-buy literature with the aim of uncovering the strategic logics or considerations that influence a company's firm boundary decision to insource or outsource a given set of activities. The review of said literature leads the study to the identification of four principle strategic logics or overarching considerations, best exemplified in Santos and Eisenhardt (2005). These are: efficiency (including cost considerations), dependency (including autonomy considerations), competence (including growth considerations) and identity (including coherence considerations). Each one of these headings represents a different strategic logic (or perspective) that highlights different imperatives deemed to influence a company's sourcing decisions. Efficiency underlines the need for cost minimization, dependency puts forth the need for autonomy and self-reliance, competence considers requirements for competitiveness and growth while identity maintains the importance of coherence within an organization.

Given these findings, the study then explores the firm boundary decision, or make-or-buy dilemma that the customer firm faces through the perspective of each of the aforementioned four strategic logics and thus operationalizes the research question through the following sub-questions:

RQ1: Which efficiency considerations influence a customer firm’s decision to outsource or not activities targeted by transactionally servitized offerings?

RQ2: Which dependency considerations influence a customer firm’s decision to outsource or not activities targeted by transactionally servitized offerings?

RQ3: Which competence considerations influence a customer firm’s decision to outsource or not activities targeted by transactionally servitized offerings?

RQ4: Which identity considerations influence a customer firm’s decision to outsource or not activities targeted by transactionally servitized offerings?

Afterwards, the study is faced with the issue of articulating and operationalizing the rather abstract strategic perspectives of efficiency, dependency, competence and identity as a variety of meanings, interpretations and contents may be ascribed to each one. To overcome this difficulty, and given the finite amount of resources available to this study, a particular theoretical paradigm is elected for each one to serve as the basis for its operationalization and study. As such, efficiency is operationalized through the lens of transaction cost economics, dependency is operationalized through the guise of resource dependency theory, competence is addressed through a particular strand of the resource-based view of the firm, while identity is approached through propositions put forth by Santos and Eisenhardt (2005).

Subsequently, each strategic perspective is articulated into a specific conceptual model by compiling the relevant constructs observed in each theoretical paradigm’s extant literature. Based on the same body of past studies, each construct along with its possible constituent elements is clearly defined as to its meaning, content and operationalization. As a result, four discrete conceptual models are constructed in order to help explore a customer firm’s decisions through the four identified strategic considerations.

Finally, to answer the research questions posed, the study elects a suitable industrial context and examines the potential customers’ firm-boundary decisions with regard to a number of activities most commonly targeted by servitization efforts. To that end, appropriate measurement models are developed for each conceptual model and empirical evidence is gathered and analyzed in order to ascertain the influence of each strategic consideration.

1.2 Research design, methodology and empirical context

The research design employed is based on the logico-scientific (variance) mode of scientific inquiry and utilizes hypotheses testing and statistical inference to derive its findings. The data collection method employed is a quasi-experimental cross-sectional survey conducted through a structured questionnaire. The questionnaire is based on the measurement models developed for each of the strategic perspectives under study, and consists of a series of itemized measurement scales developed through the C-OAR-SE procedure for scale development (Rossiter, 2002). Furthermore, a variety of archival sources and information attained through informal meetings and verbal correspondences with industry stakeholders are utilized for contextualization and triangulation purposes. Finally, given the particular nuances of the servitization phenomenon, an important research design consideration has been the selection of an appropriate empirical context for evidence gathering.

To accommodate the study's empirical context requirements, the setting from which data is collected is the deep-sea shipping industry. The capital equipment identified to be susceptible to servitization efforts are the vessels' main propulsion engines. Providers of transactionally servitized offerings are recognized to be the engine designers/manufacturers while the potential customers of servitized offerings are shipping companies involved in the worldwide transportation of dry and wet cargo. Within this context, the servitized offering of marine engines requires shipping companies to outsource their engines' planned and non-planned maintenance functions to the servitization provider. Consequently, the study targets a set of six activities what collectively make up the aforementioned engine maintenance functions, and enquires the shipping companies with regard to each activity's sourcing profile and management circumstances.

An activity's sourcing profile is defined as the level to which an activity is outsourced or, in reverse, the level to which an activity is performed in-house. Each activity's sourcing profile is treated as a discrete firm-boundary decision and acts as the study's main dependent variable sought to be influenced by each strategic consideration's operationalized constructs and conceptual rationale. Analysis is conducted at the level of maintenance activities. As such, the study's unit of analysis comprises the maintenance activity.

The study's empirical research target population consists of deep-sea dry and wet cargo shipping companies operating vessels upwards of 1,000 Dead Weight Tonnage (DWT). To be more technically precise the target population is actually the said companies' six focal maintenance activities. In the interest of simplicity, however, the sampling characteristics are offered at the shipping firm level here. The study's sampling frame is consisted by the shipping firm membership lists of two international shipping associations, namely, INTERCARGO and INTERTANKO. INTERCARGO is the International Association of Dry Cargo ship-owners, while INTERTANKO is the International Association of Independent Tanker Owners. As of 2011, both organizations' memberships collectively accounted for approximately 12,3% of the world fleet (in no. of vessels) and over 32.7% of the world fleet's carrying capacity (in DWT). The sampling frame includes 241 companies from a total of 38 countries (with 15 countries accounting for 87% of the membership total). While the sampling frame is technically one of convenience, it is put forth that its international diversity and world fleet representation rates allow it to be considered as an acceptable compromise between practical considerations and validity requirements.

Data collection was conducted over the internet through a secure self-administered structured survey instrument developed on the Qualtrics survey research suite (Qualtrics Labs, 2012). Funding for the use of the survey system was kindly provided by Warwick Business School's Doctoral Programme Office. Given the idiosyncrasies of the phenomenon of interest, the study's informants included any of the following shipping company functionaries (one per respondent firm): the Chief Technical Officer, Fleet Manager, Technical Manager or Chief Superintendent Engineer (in more than a few instances the informant has even been the company's CEO). Additionally, conceptual clarifications as well as technical assistance were consistently offered to all of the survey's informants through verbal correspondences to ensure common frames of reference. Sixty marine shipping firms successfully completed the survey instrument, thus yielding a total sample of 360 maintenance activity observations (60 firms x 6 maintenance activities).

Data analysis, finally, was conducted through a series of hierarchical logistic and multiple regression model-building processes aimed at exploring the statistical significance of each strategic perspective's considerations in two key dependent outcomes. The first outcome was defined as a categorical dependent variable depicting the sourcing state of a maintenance activity. Two sourcing states were involved: '0', meaning activity not outsourced at all (i.e. performed in-house) and '1', meaning activity outsourced to any degree. This dependent outcome was used in the exploration of the various considerations' influence on the decision to outsource an activity or not, through hierarchical logistic regression. The second outcome was defined as a continuous dependent variable depicting the outsourcing level (or otherwise the degree of outsourcing) of a maintenance activity given that the activity is outsourced to any degree. This second dependent outcome was used in the exploration of the various considerations' influence on the level of activity outsourcing once the decision to outsource has been established, through hierarchical multiple regression.

Given the above, the statistical analyses were performed on two datasets. The first comprised all of the 360 observations of maintenance activity cases while the second (being a subset of the first) comprised only 195 observations where maintenance activities were outsourced to any degree. The reason for this dual and progressive analysis approach is that the servitization initiatives of interest in this study, i.e. performance-based contracts, not only aspire to elicit the outsourcing of activities on behalf of potential customers but further aim that said outsourcing is performed to an increased degree (i.e. with as much of an activity's performance and responsibility attributes being outsourced).

1.3 Research limitations

A number of limitations narrow the scope of this study of the servitization phenomenon. Primarily, while the general phenomenon of interest is identified as the servitization of manufacturing, the study is limited to the investigation of a particular manifestation of the phenomenon, namely performance-based contracts for long-life capital equipment. Furthermore, a potential customer firm's propensity to accept transactionally servitized offerings is approximated through the customer firm's propensity to outsource activities most commonly targeted by such offerings. Dependent on the operational breadth and depth of a particular servitized offering and the capital good involved, other activities may need to be considered as well.

Additionally, the study explores the customer firm's point of view through four strategic perspectives, namely, efficiency, dependency, competence and identity, with each perspective articulated through a particular theoretical framework. Other strategic perspectives and alternative theoretical frameworks could inform further investigations of the phenomenon and provide additional insights.

With regard to the methodology employed, the study is limited by being structured around a quasi-experimental cross-sectional survey research design. While a longitudinal approach is acknowledged to have many benefits to offer, it is excluded due to practical considerations and resource constraints. Similarly, it is also recognized that a study of servitization could profit from the benefits of formal case study approaches. Their absence is offset by the consideration of extensive archival information in conjunction with verbal correspondences and informal meetings with a significant number of the survey's informants.

Finally, the study is limited in the empirical examination of a single, though global, industrial sector at a particular moment in time while further focusing on the servitization of a particular technological artefact (i.e. shipping firms' ship main propulsion engines).

1.4 Thesis structure

The present thesis is structured around ten chapters. Chapter one as already established constitutes an introduction to the phenomenon of interest as well as the study's overview, research design, methodology and empirical context particulars. Furthermore, the chapter delineates the study's scope and subsequent limitations while also offering the current thesis structure overview.

Chapter two seeks to establish the study's philosophical standpoint and underlying philosophical assumptions with regard to the ontology of phenomena of interest and the epistemology through which access to their properties is strived for.

Chapter three offers the study's literature review and conceptual analysis of the servitization phenomenon in general. In so doing, the chapter establishes that there are different forms of servitization. Furthermore, by delineating each form's characteristics and theoretical underpinnings, the chapter provides a conceptual basis for the particular form of servitization investigated in this study (i.e. transactional servitization).

Chapter four provides a literature overview of transactional servitization as manifested in the offering of performance-based contracts. Additionally, the chapter conceptually analyses the meaning of such servitized offerings from the customers' point of view and establishes that their acceptance constitutes a firm boundary or outsourcing dilemma for potential customer firms.

Chapter five offers a literature review and conceptual analysis of the four strategic perspectives through which the customer firm's boundary dilemma is explored. The chapter articulates each strategic perspective through a respective theoretical framework and delineates each framework's assumptions, conceptual rationale and sourcing state discriminating attribute hypotheses. Any novel assertions or complementary hypotheses put forth by this study are included in this chapter's respective theoretical framework sections.

Chapter six articulates the requirements for a suitable empirical context, in which to explore the study's hypotheses, and proceeds to its identification and description. The chapter further identifies a suitable focal technological artefact subject to servitization initiatives and further designates the particular focal activities targeted by transactionally servitized offerings. Finally, the chapter identifies a number of potentially confounding extraneous considerations particular to the empirical context that need to be controlled for.

Chapter seven formulates the methodological foundation of the study. In so doing, the chapter delineates the study's identified research gap, research questions and boundaries, approach, methods of inquiry and research design. Furthermore, the chapter reports on the study's empirical research target population, sampling frame, sampling strategy and informant requirements.

Chapter eight describes the study's measurement model development and data collection processes. In so doing, the chapter reports on the study's application of the C-OAR-SE method for measurement scale development and further recounts issues surrounding the development and administration of the study's survey instrument.

Chapter nine presents the study's empirical data preparation and data analysis processes while further offering a complete report of the empirical results and findings. As such, the chapter recounts the procedures followed during the data screening and missing value treatment processes and subsequently reports on the hierarchical logistic and multiple regression statistical analyses performed to explore the study's hypotheses.

Chapter ten, finally, provides a summary of the empirical research's findings and further offers a theoretical discussion of both their interpretation and subsequent implications to the academic discourses engaged. In conclusion, the chapter articulates a number of implications pertaining to practitioners of servitization and further offers recommendations for future studies.

Chapter 2

Philosophical standpoint and assumptions

2.1 Introduction

Any type of scientific research endeavour is unavoidably underscored by a particular philosophy of science that guides the researcher's understanding of the nature of a phenomenon of interest (ontology) as well the means through which knowledge and understanding of it may be achieved (epistemology) (Van de Ven, 2007:14). This chapter confers the principal ontological and epistemological standpoints informing this study of the servitization of manufacturing phenomenon.

2.2 A critical realist ontological standpoint

Principally underlying this research's ontological views are ideas derived from the philosophical tradition of critical realism (CR) (Bhaskar, 1975; 1979; 1998). Identified as a middle-ground between positivism and relativism (Collier, 1994; Van de Ven, 2007), critical realism purports a firm realist ontology in that there is an existing, causally efficacious, world 'out there' that is independent of our perception and knowledge thereof (Archer et al., 1998). As Fleetwood (2002:29) puts it:

> "To be a realist is to assert the existence of some disputed kind of entities such as gravitons, equilibria, utility, class relations and so on. To be a scientific realist is to assert that these entities exist independently of our investigation of them. Such entities, contra the post modernism of rhetoricians, are not something generated in the discourse used in their investigation. Neither are such entities, contra empiricists, restricted to the realm of the observable. To be a critical realist is to extend these views into social science" (Fleetwood, 2002:29)

In particular, Bhaskarian critical realist philosophy assumes three ontological domains of reality where generative (or causal) mechanisms, events and observations are thought to occur. These include: (1) the domain of the real, where all of the above are thought to reside, i.e. the underlying mechanisms that generate relations, events and behaviours, the events and behaviours themselves as well as any active observations of said events and behaviours, (2) the domain of the actual, where only the generated events and behaviours are thought to reside, and finally (3) the domain of the empirical, where specific observations of particular events and behaviours are consciously carried out (Archer et al., 1998). Within such an ontological framework, it is thus recognized that generative mechanisms (considered usually as the primary point of inquiry) exist independent of our knowledge or understanding and that these mechanisms bring forth events and behaviours that occur but may be observed or not while finally observations are limited studies of events or behaviours resulting from actualised real mechanisms.

Within this triadic conceptual ontology the critical realist philosophy of science considers the primary generative or causal mechanisms as an intransitive dimension in the sense that these mind-independent mechanisms do not change with our evolving perception of them. In contrast, a transitive dimension is ascribed to mind-dependent, social endeavours such as theories, scientific inquiries and research programmes attempting to reach and understand the intransitive dimension. As a thorough presentation of CR philosophy falls outside the scope of this study, the interested reader is directed at the insightful writings provided by Archer et al. (1998) as well as Sayer (2000) among others.

2.2.1 A basic ontological approach of the servitization of manufacturing

In a somewhat deductive process of reasoning, a presuppositional view of the servitization of manufacturing phenomenon adopted in this study is presented in this section. Servitization is thought of as a mode of commercial[1] activity enacted by a profit-seeking organization[2]. The term servitization of manufacturing is thought to presuppose the existence of manufacturing operations, the products of which are the objects of servitization (in the particular manifestation of servitization under study, at least). As a mode of commercial activity, servitization is also thought to presuppose the existence of commerce in the sense of transactional activities. Furthermore, as an activity enacted by a profit-seeking organization, servitization further presupposes the existence of a macro-organizational structure that permits the generation of profit (i.e. a free-market economy).

In continuing this reasoning discourse, it is argued that manufacturing operations at their most basic form presuppose the existence of tools (i.e. manufacturing equipment), raw materials (at the very top of the manufacturing chain), people (although not necessarily in the actual production process) and technology. Tools presuppose raw materials, people and technology while exploitable raw materials presuppose natural resources, people and technology. Natural resources presuppose nature while technology presupposes knowledge of the natural world, and people able to translate that knowledge in technical practices. Finally, knowledge of the natural world presupposes nature and people willing to study the natural world.

Commerce, in turn, is thought to presuppose the existence of people who are willing to make dealings with other people while a profit permitting organizational structure presupposes the existence of a transactional medium that permits the realization of profit (i.e. some form of currency). The willingness to perform dealings between people is thought to presuppose human needs and wants that drive such activities in order to be satisfied while a transactional medium presupposes people who have agreed upon said medium in order to conduct their dealings.

Through this approach, it has been inferred that servitization may be thought to presuppose nature and people. Thus, it is permitted and restricted both by natural (transcendentally intransient) and human (principally transient and socially constructed) powers and tendencies. In other words it may be suggested that the servitization of manufacturing is a transient or "only relatively enduring" (Bhaskar, 1979:38) socially constructed (Hacking, 1999) phenomenon allowed to manifest by a series of other equally transient socially constructed structures, and one that remains subject to both the powers and tendencies of the social constructs that permitted it as well as those of a relatively intransient natural reality. Though this analysis may simply illustrate truism, it was deemed worth performing in order to serve as a vehicle that reflects the author's personal perceptions of what constitutes the domain of the real for the servitization of manufacturing phenomenon.

[1] Where commerce is defined by the Oxford English Dictionary as: (1) the activity of buying and selling, especially on a large scale, or as (2)[(dated)] social dealings between people.

[2] The concept of servitization is not considered to be necessarily limited to the offerings of an organization as a craftsman may provide offerings of a similar nature, although at a severely limited scale.

2.2.2 A more nuanced stratified ontological view

A stratified view of the world is one that is adopted by the author. Differing levels of reality or contextual conditions are believed to govern different phenomena (as described in the epistemology of critical realism in Ackroyd, 2004:150). Respectively, it is further held that similar phenomena may be generated by similar tendencies which according to the prevailing conditions may be possessed by the enacting systems (Tsoukas, 1989) yet be unexercised, unrealized or even unperceived by the researcher (Bhaskar, 1975). Furthermore, as it was illustrated in the previous section, servitization is considered to by no means be the outcome of a singular influence originating from either the social or natural systems that presuppose it. It is considered to be the product of generative mechanisms structured in particular ways that originate from different strata of both systems.

In attempting to reconcile the differences between the complex natural and social systems (or structures) that allow servitization to emerge, the author adopts as Collier puts it "(…) not a difference of principle, only of degree." (1994:245):

> "Social structures are certainly only relatively enduring; the laws governing capitalist economies did not operate in the high Middle Ages or earlier, (…). They did not operate because they are the tendencies of a certain kind of structured entity (a capitalist economy), and such entities did not exist at that time. (…) In that sense, they are not space-time invariant. But in another sense they are: that whenever economies with the relevant structure exist, these tendencies operate. So these laws can be formulated in terms which are universal, by virtue of being conditional (…)" (Collier, 1994:244)

In more practical terms, let us consider the case of a profit-seeking organization aiming to servitize its products in a particular industry segment. Given (or preferably under the condition) that the firm operates in a capitalist or free-market economy and is chartered within the boundaries of a specific country, then there exists a specific and clearly articulated set of national legally binding laws and rules of commerce that define an environmental reality with which the firm is obliged to comply. Additionally, given that the firm seeks to servitize in a particular industry segment, further constituents of that environmental reality may come into play. For example, as is presently the case in the merchant marine propulsion engine industry (the study's empirical context), any manufacturer seeking to promote products and services within this specific industry must adhere to the directives and regulations of the United Nation's International Maritime Organization (IMO). Thus, an extra layer is added to the reality in which the firm is required to operate.

In light of the practical example given in the previous paragraph, it may be argued that these regulatory laws, rules and directives, in so far as they are enforced and applied with near ubiquitous frequency, can be viewed as compelling restrictions and enablers as natural laws. The only distinguishing characteristics between them are of course the socially constructed origins and relatively transient enforcement and manifestation of the former to the naturally constructed origins and relatively intransient enforcement and manifestation of the latter (i.e. gravity). And, while this analogy may carry credence as long as firms seek to abide by the written rules of the proverbial game of each respective industry, it could be weakened by players seeking their fortune in various creative interpretations of those rules. Consequently, in such cases, an additional concealed layer of the business reality may lay to be discovered.

In summarizing the ontological approach of the servitization phenomenon reported in this section, it is held that any observed or documented exchange of a servitized product at a given point in time would be the product of certain tendencies present within the natural and social systems (or structures) that gave rise to servitization. Servitization is believed to exist as part of a natural and social reality that is ‘out there’ regardless of the researcher’s observational and perceptual abilities. This proposition should then elucidate the author’s ontological position concerning servitization as that of a critical realist’s. Hence, the challenge for the student of servitization is to uncover the particular generative mechanisms whose conditions, structure and configuration allow its manifestation and relative attributes.

2.3 Epistemological views on the progression of scientific knowledge

Having established a particular worldview (or ontology) of the specific business phenomenon under research, it is time to address the epistemological philosophical assumptions underlying this study of the servitization of manufacturing phenomenon. As Ackroyd (2004:139) states:

> “(…) different approaches to study are rooted in different philosophical positions; that is, in different conceptions of the world (ontology) and [different conceptions of] how to achieve knowledge of it (epistemology).” (Ackroyd, 2004:139)

To better illustrate the study’s epistemological foundations, it is deemed prudent to first address the viewpoint adopted with regard to the issue of scientific knowledge progression. As any academic study is not devised in a vacuum but rather extends upon previous research endeavours, this research subscribes to ideas derived from Campbell’s evolutionary perspective of scientific knowledge progression (Campbell and Paller, 1989; Van de Ven, 2007:61-62).

In accepting an evolutionary perspective of scientific knowledge progression, the study acknowledges that science progresses through a process of blind variation and selective retention. Van de Ven (2007:62) provides a lucid illustration of this viewpoint in articulating its more salient points as follows:

> “(1) science is a process of error-correction; (2) science is based on evidence obtained from outside of the scientists about the world; and (3) while evidence is theory-laden and error-prone, it is nevertheless useful for discriminating between plausible alternative models of understanding a phenomenon in question. (…) The theories and models that better fit the problems they are intended to solve are selected, whereas those that are less fit are ignored or winnowed out.” (Van de Ven, 2007:62)

Given the aforementioned view of the progression of scientific knowledge, it is acknowledged that contemporary and emerging theories and models associated with a particular phenomenon are the product of such a constantly on-going selective retention process. This study strives to be a cumulative part of this perpetual process of scientific enterprise. In particular, given the conceptually mature state of insourcing/outsourcing theory and firm boundary decision models with which servitization is linked, the study attempts to consolidate a state-of-the-art view of related theoretical frameworks and further incorporates a confirmatory ‘theory testing’ aspect aimed at promoting the next evolutionary iteration of scientific knowledge in the chosen field of research.

2.4 Methodological views on achieving knowledge

Moving, finally, to the means of achieving knowledge of a particular phenomenon, the study maintains the contextual and stratified critical realist view presented in the previous section and continues to recognize degrees of relative transience among the complex phenomena of the natural and social world (Collier, 1994). As Ackroyd (2004:146) on his commentary of Marx, Weber, Mannheim and Parsons' positions, notes with regard to the social world:

> "(…) the constructed world is not merely socially constructed, but acquires an independence from individual people and groups. The institutional structure manifestly has independent effects on behaviour whatever the constructors think about the matter." (Ackroyd, 2004:146)

At the same time, it is thought that the adoption of either a naive empiricist's (purely positivistic) or a constructivist's (purely hermeneutic) viewpoint would offer only a limited view of the generative mechanisms of a phenomenon under study. In the case of the former due to a methodological framework that largely overlooks issues of motivation and meaning while in the case of the latter due to a framework that over signifies the same issues while somewhat overlooking the quasi-universal, albeit conditional laws of particular socially structured entities (e.g. the merchant marine engine industry's collective rulebook described earlier).

Given the foregoing acknowledgement, the study ascribes to methodological pluralism in the sense that different methodologies or means to strive for knowledge of a phenomenon are recognized to contextually better suit different kinds of research inquiries (i.e. different methodologies may be better suited to answer 'what' or 'how' types of research questions) (Van de Ven, 2007). At the same time, however, it is also acknowledged that differing methodologies applied to the same line of scientific inquiry may provide alternative, complementary, or more in-depth and equally important insights with regard to various aspects of the phenomenon of interest. As such, the relativist idea of incommensurability is rejected and the value of methodological triangulation is acknowledged. Nevertheless, it is equally noted that methodological triangulation may not always be feasible in the cadre of a specific research programme due to resource constraints.

Building upon the last point of the previous paragraph, and specifically in light of the resource constraints posed upon a PhD thesis, this research makes a series of methodological choices that reflect a succession of conscious decisions informed by: the state, or maturity, of contemporary research with regard to the issues under study, the relative strengths and drawbacks of each methodology with regard to the study's particular research questions as well as the academic strengths and weaknesses of the researcher. As such, the methodologies enacted within this study are believed to enable the researcher to gain better access to the phenomenon given the study's research aims while also better aligning themselves with the researcher's technical abilities, cultural and vocational bias (e.g. that of an industrial engineer).

More specifically, the study focuses principally on a line of inquiry that parallels 'what' rather than 'how' types of research questions in seeking to uncover antecedents of the servitization of manufacturing phenomenon. As such, the study aligns itself with a variance-based logico-scientific model (Mohr, 1982) or otherwise an 'outcome-driven' (Aldrich, 2001) exploration of a series of input factors that attempt to (statistically) explain change in some outcome state (Van de Ven, 2007). In pursuing 'what are the antecedents of the issue?' types of research questions, the study is recognized to assume or hypothesize specific answers to the associated 'how' questions (Ibid.) which, in turn, are considered to be well-covered in the body of research preceding this study. A further elaboration of the specific assumptions and premises of the study's methodological aspects is conducted within this thesis's methodology chapter.

2.5 Some concluding remarks

Having established a specific worldview of servitization and having posited possible means by which certain knowledge of it may be acquired, it should go without saying that the ontological and epistemological views that reflect critical realism are in no way considered to be some faultless or final 'true' philosophical position. The point is clearly illustrated by the enduring and most interesting discussions regarding several of its aspects, such as the basis for its ontology (Reed, 2005a; Contu & Willmott, 2005; Reed, 2005b). The same of course holds true for any particular philosophical position. As Ackroyd (2004:145) puts it:

> "There is not a philosophical postulate that is generally accepted as correct and which cannot plausibly be denied on the basis of alternative assumptions." (Ackroyd, 2004:145)

Therefore, it is the duty of any student of science to acknowledge the limitations posed by both the finite nature of human perceptual abilities and personal bias as well as those put forward due to restricting and perhaps inadequate assumptions. Given this premise, it is openly recognized that any product of this research effort will at best yield a limited and fragmented view of what is considered to be 'out there'. And while this rather pessimistic view may be loosened in the case of replicable experiments conducted in closed systems, it certainly holds true in the case of open and self-reflective systems such as business markets and industries. Nevertheless, all is not lost. For as long as there are also plenty of research communities 'out there' applying a variety of rigorous approaches to the study of the same phenomena, the potential for better and more insightful views of our world emerges. And it is certainly only through that collective effort that we may progress and advance our understanding.

Chapter 3

Theoretical Foundation of Servitization

3.1 Introduction

The concept of servitization, a term originally coined by Vandermerwe and Rada (1988), to denote the enrichment of core corporate offerings through the provision of services, has received increasing attention in academia in recent years. Independently, several streams of literature exploring (implicitly or explicitly) the basic premises of servitization have been developed. Among them, the topics of *support services* (Goffin and New, 2001), *after-sales services* (Armistead and Clark, 1991), *supplementary services* (Anderson and Narus, 1995), *product-service systems* (Manzini and Vezolli, 2003), *systems integration* (Davies, 2004), *performance-based logistics* (Kim et al., 2007) as well as others are being explored (Spring and Araujo, 2009). This study focuses on the performance-based contracts/logistics paradigm manifestation of servitization. Before addressing this focus area, however, a better definitional and conceptual understanding of the notion of servitization is deemed as a necessary step preceding any attempts towards the observation and explanation of this phenomenon.

The term *Servitization* was initially introduced by Vandermerwe and Rada (1988, p.314) as the movement in which “corporations are increasingly offering fuller market packages or *bundles* of customer-focussed combinations of goods, services, support, self-service, and knowledge”. Ever since, the concept has been referred upon as a trend (Vandermerwe and Rada, 1988; Lindberg and Nordin, 2008), a generic term (Slack, 2005), a change, a managerial philosophy (De Toni et al., 1994), a model, a concept (Robinson et al., 2002), a strategy (Ahlström and Nordin, 2006; Lindberg and Nordin 2008) a process (Brax, 2005) as well as an innovation (Neely, 2008), among other things, in a variety of contexts. Conflicting or otherwise dissimilar definitions and views are also present in the literature. For example, Slack et al. (2004, p.384) note that “companies … are becoming aware of the value of the servitization of their products. That is, marketing the capability that their products bring”. Johnson and Mena, (2008, p.27) denote servitization as “the bundling of products and services” while Pawar et al. (2009, p.469) refer to it as “a transition… from an emphasis on the manufacture of products to the provision of service”.

In order to untangle this complex web of terms, qualifications and meanings, a review of contemporary (2000-2009) journal literature explicitly referring to the term is undertaken. From the identified literature, definitional views of servitization are extracted and analysed through summative content analysis (Hsieh and Shannon, 2005). Guiding this literature analysis are two principle questions: ‘What is servitization?’ and ‘What does servitization involve?’ or, in other words, ‘How can a manufacturing firm perform servitization?’.

The review finds that consensus in what servitization is has yet to be reached and that there are two emergent notions, both pertinent to the servitization concept, which so far have been seemingly treated in an aggregate rather than nuanced way. Consequently, it is proposed that these notions represent significantly different approaches to servitization and therefore warrant individual or at least contingent study.

3.2 Servitization in the literature

This section strives for a better understanding of the servitization concept. Therefore, the two principle research questions guiding the literature analysis are ‘What is servitization?’ and ‘What does servitization involve?’. Of further particular interest in the inquiry, is the nature of the relationship between the product (or good), the service(s) and the corporate offering in a servitization context. In more basic terms, the goal is to understand what may potentially be offered in the context of servitization, by a servitizing firm.

3.2.1 Literature analysis methodology

The purpose of the literature data collection process is the identification of journal papers that provide definitional qualifications and/or viewpoints (both henceforth referred to as contributions) explicitly referring to the servitization concept. At this point, it should be noted that the literature addressing issues such as service management, after-sales services, integrated solutions, product-service combinations, product-service systems, and many other topics closely or loosely related with servitization, is vast to say the least. However, it is not the purpose of this study to provide a comprehensive review of large portions of the modern marketing, operations management and engineering literature. As the objectives revolve around the clarification of what servitization is and to what it is to refer, the search is limited in journal papers that explicitly refer to the term. For a summary of the aforementioned fields' evolution and involvement in the broader servitization dialogue see Pawar et al. (2009) and Sakao et al. (2009).

The following strategy is implemented for the collection of literature data:

1. Primarily, a search was conducted in a variety of databases such as ABI/Inform, Business Source Premier, Ebsco EJS using the keywords 'servitization' and 'servitisation' (as it is sometimes worded).
2. The time frame set for the search spanned the period from 2000 to 2009. This specific time frame was selected in order to yield results that would portray a contemporary view of servitization.
3. The initial search generated 53 papers which were firstly checked for duplicates and secondly reviewed briefly in order to ascertain their content for contributions to servitization. Papers that were not explicitly referencing the term in their main body of text and papers that made no outwardly significant contribution were discarded.

In total, the search yielded 16 papers from 10 different journals which are listed in Table 3-1.

Table 3-1. Papers with explicit references to servitization

Author(s)	Journal
Robinson et al. (2002)	The Service Industries Journal
Slack et al. (2004)	International Journal of Operations & Production Management
Brax (2005)	Managing Service Quality
Slack (2005)	Gestão & Produção
Åhlström and Nordin (2006)	Journal of Purchasing and Supply Management
Nordin (2006)	Leadership & Organization Development Journal
Johnson and Mena (2008)	International Journal of Production Economics
Johnstone et al. (2008)	The Service Industries Journal
Lindberg and Nordin (2008)	Industrial Marketing Management
Neely (2008)	Operations Management Research
Baines et al. (2009a)	Journal of Manufacturing Technology Management
Baines et al. (2009b)	International Journal of Operations & Production Management
Johnstone et al. (2009)	International Journal of Operations & Production Management
Lewis and Howard (2009)	International Journal of Automotive Technology and Management
Pawar et al. (2009)	International Journal of Operations & Production Management
Schmenner (2009)	International Journal of Operations & Production Management

In order to establish a basic cognitive reference point from which all subsequent contributions may be contextualized, the study also includes Vandermerwe and Rada's (1988) writings, who were the first to coin and make use of the term. In the interest of parsimony, a meticulous though not exhaustive review of that paper is presented in section 3.2.2.

Subsequently, the identified papers were reviewed with particular attention paid in sections that explicitly refer to servitization in order to extract viewpoints and/or definitions. The aforementioned sections' review is presented in section 3.2.3. Individual contributions were then identified and constructed at the level of a sentence through minor syntactical and grammatical modifications (section 3.2.4). The reconstructed contributions along with their respective authors are presented in Table 3-2.

Finally, the contributions were used as data in a summative (manifest as well as latent) content analysis (Hsieh and Shannon, 2005) performed in order to explore the existence of any emergent structures. In utilizing a summative content analysis approach, the following assumptions as per Huff (1990) and Duriau et al. (2007) are acknowledged:

1. Analysis of texts permits access to cognitive schemas,
2. Groups of words reveal underlying themes and
3. Co-occurrences of keywords may be interpreted as reflecting association between underlying concepts.

Two coders were employed, the thesis author and then thesis supervising professor. The coding schemes reported were reached through a reiterative coding process (Weber, 1990) until acceptable inter-coder reliability was achieved. At this point, it is noted that in the analysis of content, the emergence of structure is expressed purely in qualitative rather than quantitative terms. Finally, issues of credibility and internal consistency are addressed through the presentation of the original textual evidence in section 3.2.4 (Weber, 1990).

3.2.2 The initial contribution to servitization

Having discussed the methodological issues of the literature study, this section focuses on the presentation of textual evidence from journal literature that explicitly references and provides a viewpoint of servitization. For reasons articulated in the previous methodology section, the first paper that made use of the term (i.e. Vandermerwe and Rada, 1988) is reviewed first, subsequently followed by the review of evidence from contemporary journal literature.

In moving towards a better understanding of servitization, and to establish a fundamental cognitive reference point, it is deemed essential to begin with the 'roots' as it were of servitization. Thus, the study is directed to the writings of Vandermerwe and Rada (1988), the first authors to coin and make use of the term. Based on interviews of senior executives of both service and manufacturing companies, Vandermerwe and Rada (1988) attempted to articulate the importance of services in the formulation of corporate strategy and endeavoured to illustrate some of the advantages as well as competitive impacts of such a shift in strategy. Their principle argument is that firms should not remain fixed to either a core-product or a core-service approach in their effort to meet their customer's needs. Instead, they argue that the customer's needs should be the basis for the development of the corporate offering which could include products as well as services and other elements that go beyond the firms' core business activities.

According to Vandermerwe and Rada's (1988, p.314) opening statement, the servitization of business is a trend in which "More and more corporations throughout the world are adding value to their core corporate offerings through services". There are two points of interest in this phrase. Primarily, it is the fact that the phrase refers to the servitization of business in general, rather than, say, the servitization of manufacturing in particular. The second notable point is that value is considered to be added to the corporations' core corporate offerings regardless of whether these are products, services or combinations of them. It is for the same reason that the authors carefully choose their phraseology when referring to a company's principle revenue generating mechanisms as 'core business activities'.

Further indicators of this mentality may be observed in the more concise definition of the term offered immediately after the previous proposition. In qualifying their initial statement Vandermerwe and Rada (1988, p.314) propose that servitization is the movement in which "corporations are increasingly offering fuller market packages or 'bundles' of customer-focussed combinations of goods, services, support, self-service, and knowledge. But services are beginning to dominate". Again, there are two points of interest in this qualifying definition. Primarily, it is the fact that servitization is coupled with the process of 'bundling' different possible constituents of a market proposition in order to create a 'fuller' market package. Secondly, it is the fact that by acknowledging the dominance of services in the creation of this 'fuller' market package, they propose that (1) services are different from 'support', 'self-service', 'knowledge' and 'goods' and (2) that services (at least in the end of the 80s) seem to dominate this 'fuller' market package creation process.

At present, it is worthy to note that the leeway and flexibility presented by Vandermerwe and Rada (1988) to manufacturing and service firms alike in creating what they call a 'fuller' market package is extensive to say the least. In order to illustrate this leniency, and without getting into more detail, we simply turn our attention to Vandermerwe and Rada's (1988, p.315) discussion 'On definitions and No-Definitions'. In that section of their paper, the authors primarily recognize the existence of various definitional problems with the word 'services' and subsequently adopt the view that services are intangible and performed while goods are tangible and produced. While they precariously overcome this hindrance as an issue outside the scope of their study though, they remain adamant on two issues concerning products and services.

Firstly, they recognize that there exists a substitutional relationship between goods (products) and services, meaning that one may be substituted by the other (e.g. a barber service being substituted by an electric razor or a bank clerk by an ATM machine as well as a PC being substituted by a Terminal Service). Secondly, they accept that there is that there is 'total complementarity' between products and services. As they put it, "It's hardly necessary to say that essentially all products produce services" and that "Services [can be] built into goods" (Vandermerwe and Rada, 1988, p.315). In order to defend this 'materialization' of services process and their subsequent incorporation in goods they put forth the example of "future artificial intelligence (A.I.) [that] will make it possible for firms to anticipate failure and repair the damage without customers knowing that anything went wrong". These future technologies, though not in the form of true A.I. but rather Expert Systems, are now well within the grasp of current technologies in the form of Remote Monitoring Systems (RMS) and self-diagnostic mechanisms incorporated in 'smart products' (Allmendinger and Lombreglia, 2005).In summarizing the findings from the initial contribution to the servitization dialogue, it is noted that according to Vandermerwe and Rada (1988):

- The servitization of core business activities (which may be any combination of goods and services), may be performed with any combination of goods, services, support, self-service and knowledge in order to create a 'fuller' market package (or otherwise a better value proposition for customers)
- Services are (or may be) distinct from support, self-service, knowledge and goods (depending on definitional assumptions)
- Services may be substituted by products and products by services
- Services may be produced by products
- Services may be incorporated in products

The implications of these findings in the attempt to better understand the nature of servitization can be abridged in stating that the original premise upon which the servitization term was coined is an all-permissive and exceedingly flexible framework where firms are allowed to 'servitize' with multiple degrees of freedom.

3.2.3 Contemporary contributions to the Servitization dialogue

Having revisited Vandermerwe and Rada's (1988) initial paper on the servitization of business, this paragraph turns to the explicit references of servitization identified in the collected sample of journal papers. In the interest of clarity, the references are presented in chronological order.

Robinson et al. (2002) view servitization (or servitisation as they word it) as an extension of Levitt's (1969) concept of the 'augmented product' and in citing Vandermerwe and Rada, (1988) dub it "[a concept] which goes beyond the traditional approach of providing additional services but considers the total offer to the customer as an integrated bundle consisting of both the goods and the services" (Robinson et al., 2002, p.150).

Slack et al. (2004, p.384), upon contemplating issues surrounding the field of operations management note that "companies … are becoming aware of the value of the servitization of their products. That is, marketing the capability that their products bring". In a revisit of the concept shortly thereafter, Slack (2005, p.326) states that "Servitization is the generic (if somewhat unattractive) term that has come to mean any strategy that seeks to change the way in which product functionality is delivered to its markets". An almost identical viewpoint is also proposed by Lewis et al. (2004).

Contemporarily, upon investigating the transition of a manufacturer to a service provider Brax (2005, p.146) would reportedly adopt Vandermerwe and Rada's (1988) view of servitization as a process in which "companies [are] adding more and more value to their core offering through services [while] experiencing a shift in their core business". Shortly after providing this interpretation of the servitization of business, however, the author appears to misconstrue Vandermerwe and Rada's (1988) possible historical evolution of the servitization of business as a prescriptive stage-like evolutionary process applicable to any firm. It is posited that a keen reading of the original paper reveals this prescriptive notion not to be among the points put forth by Vandermerwe and Rada (1998).

Within a business-to-business service provision context and while studying service supply relationships, Ahlström and Nordin, (2006, p.77) draw from Frambach et al.'s (1997) work on proactive product service strategies, and refer to servitization as a manufacturing company's attempt (perhaps strategy) "to establish service supply relationships to deliver product services [in order] to augment their physical products" and thus "differentiate themselves from the competition by offering a higher level of services than their competitors" (Ahlström and Nordin, 2006, p.78). In the mean time, when referring to a particular company's goals in the pursuit of servitization (with no identifiable qualifier), Nordin (2006, p.302) includes the provision of "business solutions, full maintenance contracts, and managing customers' operations" as strategically key objectives all the while leaving services such as "repair, product support, product-oriented training, installation, [and] systems integration" in a rather secondary role.

In studying the provision of complex, long-life servitized products through a Supply Chain Management perspective, Johnson and Mena (2008, p.27) accept Slack et al.'s (2004) view of servitization as a strategy and interpret Vandermerwe and Rada's (1988) approach to servitization as "the bundling of products and services". Subsequently, they accept that "Servitisation involves a customer proposition that includes a product and a range of associated services" (Johnson and Mena, 2008, p.28).

Upon exploring patterns in the process of buying (instead of selling) complex services, Lindberg and Nordin (2008, p.292) adopt a broad and seemingly popularized view of servitization in which they believe it to be the trend where "firms move from manufacturing goods to providing services or integrating products and services into solutions or functions". Interestingly enough, as the researchers approach servitization from the buyer's perspective, they identify "a diametrically opposed logic implying the objectification of services… by materializing, standardizing, specifying or packaging services and making them more tangible" (Lindberg and Nordin, 2008, p.292) especially during the procurement process. For a more detailed discussion of the premises of the 'objectification' of services see Araujo and Spring (2006).

Upon undertaking a study of the financial consequences of the servitization of manufacturing, Neely (2008, p.104) initially introduces the concept as the movement in which "[Manufacturing firms] move beyond manufacturing and offer services and solutions, often delivered through their products, or at least in association with them". At a later point, a possible definition of servitization is given as "the innovation of an organisation's capabilities and processes so that it can better create mutual value through a shift from selling product[s] to selling Product–Service Systems" (Neely, 2008, p.107) a viewpoint almost identically adopted also in Baines et al. (2009a). At this point, it may be inferred that the introductory definition refers to the manufacturing sector as a business segment while the latter refers to the servitization of a firm rather a product, market proposition or offering.

Concurrently, Baines et al. (2009b, p.495), refer to the concept of product-centric servitization as "the phenomena where a portfolio of services is directly coupled to a product offering" as well as the offering of "goods combined with closely related services (e.g. products offered with maintenance, support, finance, etc.)". At this point, it should be noted that the acknowledgement of a specific type of servitization (product-centric in this case) allows the inference of other possibly existing types of servitization.

While exploring value generation in automotive supply chains, Lewis et al. (2008) and Lewis and Howard (2009), primarily acknowledge servitization to be a strategy in which manufacturers place "a greater emphasis on a whole range of novel product-service combinations". Currently, it is noteworthy to point out that in their study, they identify two types of servitization strategies, namely: "'value-creating' (i.e. intended to be additive in terms of customer perceived value) and 'efficiency maximising' (i.e. intended to reduce organisational costs and be largely invisible to customers) servitization strategies" (Lewis et al., 2008). In this sense, servitization may be understood to be deployed along two dimensions. The first would be a perceived-value enhancing or value adding dimension and the second, a customer cost-reducing or outsourcing dimension.

In search for evidence of 'Product-Service' in aerospace, construction and engineering, Johnstone et al. (2008, p.862) refer to servitization (among other terms) as "the general trend away from a 'pure product' orientation towards a combined P-S [Product-Service] offering" while Johnstone et al. (2009, p.522) use the terms "a trend towards 'integrated solutions', 'P-Ss' or 'PSSs'" and describe servitization as "the increasing attention paid to developing service offerings". Along those lines, Pawar et al. (2009, p.469) refer to servitization as a phenomenon in which "a transition has been recognized from an emphasis on the manufacture of products to the provision of service" as well as "the trend towards bundles of customer focused combinations, dominated by service" (Pawar et al., 2009, p.474). Shortly, however, (and justifiably) they are quick to point out that different terminologies have been used to describe 'apparently identical phenomena' (Pawar et al., 2009, p.469).

Finally, Schmenner (2009), before driving a persuasive argument that servitization has antecedents that stretch back at least 150 years, draws upon Vandermerwe and Rada's (1988) initial contribution and treats servitization as a term "coined to capture the innovative services that have been bundled (integrated) with goods by firms that had previously been known strictly as manufacturers" (Schmenner, 2009, p.431).

3.2.4 Content analysis and findings

Having reviewed the sample literature, with particular consideration to the sections of the papers that made explicit references to servitization, a series of contributions extracted from these references were constructed. The extraction process involved the performance of minor syntactical and grammatical modifications that were deemed necessary in order to elicit coherent and meaningful propositions. The resulting reformatted propositions are presented in Table 3-2 along with their contributing authors.

Guided partially by the initial literature research questions, concerning the nature and principle function (what does it involve) of servitization, as well as by the study of the textual evidence, three content categories were identified (two manifest and one latent). Consequently, the coding process was implemented upon these content categories. The two manifest content categories were named 'Servitization qualifier' and 'Servitization function'. The qualifier category was used to indicate the word utilized for the qualification of servitization, or in other terms the word used to denote a primal meaning to the noun. The function category was used to indicate the primary function of servitization in response to the 'what does servitization involve?' research question.

Table 3-2. Identified contributions to the servitization dialogue

Author(s)	Contributing proposition
Robinson et al., 2002	Servitization is a concept which goes beyond providing additional services but considers the total offer to the customer as an integrated bundle consisting of both the goods and the services
Slack et al. 2004; Lewis et al., 2004; Slack, 2005	Servitization is a strategy that seeks to change the way in which product functionality is delivered to its markets (by marketing the capability rather than the product)
Brax, 2005	Servitization is a process in which companies are adding more and more value to their core offering through services
Ahlström and Nordin, 2006	Servitization is a strategy that seeks to establish service supply relationships to deliver product services in order to augment a physical product
Nordin, 2006	In a Servitization strategy, business solutions, full maintenance contracts, and managing customers' operations are valued over repair, product support, product-oriented training, installation, systems integration
Johnson and Mena, 2008	Servitization is a competitive strategy that involves the bundling of products and services. Servitisation involves a customer proposition that includes a product and a range of associated services
Lindberg and Nordin, 2008	Servitization is the trend where firms move from manufacturing goods to providing services or integrating products and services into solutions or functions
Neely, 2008[1]	Servitization is the movement in which manufacturing firms move beyond manufacturing and offer services and solutions, often delivered through their products, or at least in association with them
Neely, 2008[2]; Baines et al., 2009a	Servitization is the innovation of an organisation's capabilities and processes so that it can better create mutual value through a shift from selling products to selling Product-Service Systems
Baines et al., 2009b[1]	(Product-centric) Servitization is the phenomena where a portfolio of services is directly coupled to a product offering
Baines et al., 2009b[2]	Servitization is the offering of goods combined with closely related services
Lewis et al., 2008[1]	Servitization is a strategy in which manufacturers place a greater emphasis on a whole range of novel product-service combinations
Lewis et al., 2008[2]	Servitization may be either 'value creating' (additive in customer perceived value) or 'efficiency maximizing' (a form of outsourcing)
Johnstone et al., 2008	Servitization is the general trend away from a 'pure product' orientation towards a combined Product-Service offering
Johnstone et al., 2009	Servitization is a trend towards 'integrated solutions', 'P-Ss' or 'PSSs'
Pawar et al., 2009	Servitization is a transition from an emphasis on the manufacture of products to the provision of service
Schmenner, 2009	Servitization is a term coined to capture the innovative services that have been bundled (integrated) with goods by firms that had previously been known strictly as manufacturers

The one latent content category that was devised in the coding scheme was named ‘Offering’, and its primary purpose was the exploration of the underlying (or implied) relationship between the product, the service(s) and the final corporate offering. In simpler terms, it was asked ‘What is eventually the final corporate offering?; How is the core product interweaved with service(s) in order to form a corporate offering?’. Table 3-3 reports the final coding results of the reformatted contributions with regard to the aforementioned two manifest and one latent content code categories.

Table 3-3. Content codes identified in contributions

	Manifest content codes		Latent content codes
Author(s)	Serv. Qualif.	Serv. function	Offering
Robinson et al., 2002	Concept	Bundling of goods and services beyond additional	Product with Services beyond additional services
Slack et al. 2004; Lewis et al., 2004;	Strategy	Alternative mode of product functionality delivery	Product Functionality
Brax, 2005	Process	Adding value to core offering through services	Product and Services
Ahlström and Nordin, 2006	Strategy	Delivery of product services to enhance product	Product with Services
Nordin, 2006	Strategy	Alternative mode of product performance delivery	Product Functionality
Johnson and Mena, 2008	Strategy	Bundling products with associated services	Product and Services
Lindberg and Nordin, 2008	Trend	Integration of products and services in functions	Product Functions or Solutions
Neely, 2008[1]	Trend	Delivery of services through products or with products	Services through Products and Services and Products
Neely, 2008[2]; Baines et al., 2009a	Process	Selling PSS not products	Product with Services or Product and Services
Baines et al., 2009b[1]	Phenomenon	Coupling of a product with various services	Product and Services
Baines et al., 2009b[2]	Process	Offering goods with related services	Product and Services
Lewis et al., 2008[1]	Strategy	Offering product-service combinations	Product with Services
Lewis et al., 2008[2]	Strategy	Adding value or cutting cost	Product and Services or Functionality of product
Johnstone et al., 2008	Trend	Combining product with services	Product with Services
Johnstone et al., 2009	Trend	Providing combinations of product and services	Product with Services
Pawar et al., 2009	Trend	Providing services over products	Product with Services or Product and Services
Schmenner, 2009	Process	bundling services with goods	Product with Services

The first manifest content code (the servitization qualifier) was agreed upon to rely as closely as possible to the original wording of the contributing authors. This confinement was by and large satisfied in an overwhelming majority of our contributions sample, with very few exceptions requiring the uncovering of an implied qualifier (e.g. Nordin, 2006; Schmenner, 2009). In the case of the second manifest content code (the servitization function), emphasis was placed on the identification of a result potentially deriving from the adoption of a servitization strategy/process, or in the realization of a trend to servitize. Thus, the wording of the codes employed aimed to portray a resulting operation, goal or desirable outcome. Or in more inclusive terms, a function that is the result of servitization.

Finally, the latent content category employed, as previously stated, aimed to capture the implied relationship (or even the nature of the implied relationship) between the core product of a manufacturer and the services potentially provided in a servitization process. Hence, the wording of the final codes sought to provide a portrayal of what the corporate offering might be after the application of servitization. In that sense, the guides for the coding of this latent content category were primarily the underlying logic captured in the servitization function manifest content code, as well as the context of the cases explored and studies undertaken by the contributing authors.

Having completed the coding of the contributions, the emergence of any possible meaningful structures within the codes identified was investigated. Since, the second manifest content code would be utilized in the interests of the latent content code, the search for emergent structures was elected to be limited to the 'Servitization qualifier' and 'Offering' categories.

Such meaningful structures were indeed identified in both categories and are presented in Table 3-4. In the qualifier category, three overarching concepts seem to dominate the qualifiers used for the characterization of servitization. These are 'Strategy', 'Process' and 'Trend'. The key point to be made here is that strategy is regarded as an elaborate and systematic plan of action or a plan designed to achieve a particular long-term aim (Compact Oxford English Dictionary, 2010), while a trend may be regarded as a general direction, orientation, tendency or even a fashion or popular taste at a given time (ibid). A plausible argument may be made here that these two notions are not representing a common underlying perception of servitization. Thus, it is inferred that agreement on what servitization is has yet to be reached.

Table 3-4. Content analysis emergent structure

Sorting of contributions by 'Servitization qualifier'		
Strategy	Process	Trend
Slack et al. 2004; Lewis et al., 2004; Slack, 2005	Brax, 2005	Robinson et al. (2002)
	Neely, 2008[2]; Baines et al., 2009a	Lindberg and Nordin, 2008
Ahlström and Nordin, 2006	Baines et al., 2009b[1,2]	Neely, 2008[1]
Nordin, 2006	Schmenner, 2009	Johnstone et al., 2008
Johnson and Mena, 2008		Johnstone et al., 2009
Lewis et al., 2008		Pawar et al., 2009
Sorting of contributions by 'Offering'		
Product and Services	Product with Services	Product Functionality
Brax, 2005	Robinson et al., 2002	Slack et al. 2004; Lewis et al., 2004; Slack, 2005
Johnson and Mena, 2008	Ahlström and Nordin, 2006	
Neely, 2008[1]	Neely, 2008[2]; Baines et al. 2009a	Nordin, 2006
Neely, 2008[2]; Baines et al., 2009a	Lewis et al., 2008	Lindberg and Nordin, 2008
Baines et al., 2009b	Johnstone et al., 2008	Neely, 2008
Lewis et al., 2008	Johnstone et al., 2009	Lewis et al., 2008
Pawar et al., 2009	Pawar et al., 2009	
	Schmenner, 2009	

In the search for structures in the latent content 'Offering' category, the investigation yielded a further set of consequential results. Again, three overarching themes, or emerging concepts were identified. The first was labelled 'Product and Services' and was destined to denote the notion that the offering in a servitization context may consist of an otherwise unaffected core product that is sold as is and to which additional or complementary services may be further offered.

The second overarching theme, was named 'Product with Services' and was intended to signify the notion that the corporate offering consists of a core product that is combined (perhaps non-interactively) or otherwise enhanced with services. The key conceptual difference being established here, perhaps, is that services may be somehow intertwined with the product in a way that each cannot 'stand-alone', as it where, without the other.

The third and final overarching theme, presented what we believe to be an even more critical conceptual divergence from the two previous concepts. It was labelled ‘Product Functionality’ and was slated to denote the notion that the offering in a servitization context may consist of the core product being offered as a service, without the necessary provision of so-called additional services.

Again, it is held that a further plausible argument may be made here, in that the provision of additional services besides an otherwise unaffected core product, may be a significantly different approach to servitization than the provision of the core product as a service (effectively being the marketing and selling of the functionality or capability of the product instead of the material artefact).

At this point a procedural note concerning the sorting process of the contributions in each of the emerging themes is provided. While sorting by the ‘Servitization qualifier’ category, contributions were allowed to enter each category only once, while in sorting the contributions by the ‘Offering’ category, they were allowed to participate in multiple themes simultaneously. This discrepancy was deemed necessary due to the varying degree of stringency (or leniency) being offered among different contributions.

From the study of various contributions to the servitization dialogue in contemporary journal literature, it is found that:

a) Servitization may be considered to be a systematic plan designed to achieve a particular long-term aim (strategy), and also that
b) Servitization may be considered to be an ephemeral tendency or some form of popular general orientation towards a certain direction (trend)

Thus, it is concluded that consensus on the characteristics of servitization remains an on-going and debatable issue. Furthermore, the literature study has revealed that there may be three concepts directly related to the functions of servitization, or in other words, that there may be three ways by which servitization may lead to differentiated/better/servitized corporate offerings. These were identified as:

a) *Product and Services:* meaning the provision of an otherwise unaffected core product that is sold as is and to which additional or complementary services may be further offered
b) *Product with Services:* meaning the provision of a core product that is somehow combined or otherwise enhanced with services
c) *Product Functionality:* meaning the provision of a core product’s capabilities or functionality as a service, without the necessary provision of ‘additional services’

An abstract graphical representation of the identified concepts is offered in Figure 3-1.

Having achieved a reasonable level of definitional clarity, in the sense that the functions of servitization have been ascertained, a better conceptual understanding of these approaches was sought. To that end, the findings of the aforementioned analysis were interpreted through the tenets of strategy and industrial organization theory in an effort to delineate the theoretical underpinnings of servitization.

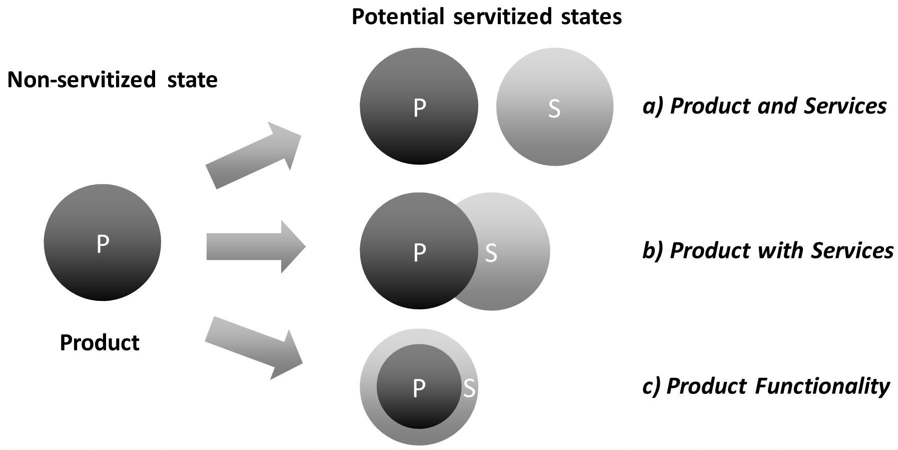


Figure 3-1. Abstract view of concepts of servitization

3.3 Theoretical underpinnings of servitization: a strategic perspective

In the broadest of terms, any form of servitization (regardless of its particular manifestation) may be viewed as an effort undertaken by firms in an attempt to create value. Indeed, as Vandermerwe and Rada (1988, p.315) put it: "since the primary objectives [*sic*] of business is to create wealth by creating value, 'servitization' of business is very much a top management issue". To comparatively examine the three approaches to servitization identified in the findings, insights are initially drawn from Porter's (1980; 1985) competitive strategy analysis frameworks and particularly from the concepts of differentiation and meeting the buyer's needs.

To paradigmatically illustrate the identified approaches, a simplified abstract model view is employed (Figure 3-2). As such, an initial non-servitized and subsequent servitized states of a given manufacturer are envisioned in which the three identified approaches are allowed to manifest. In accordance with Porter (1980; 1985) differentiation is recognized as a basic source of competitive advantage, and hence value creation in servitization. Of key interest in this analysis, however, are the particular generative mechanisms of differentiation in each approach. Primarily, the initial (non-servitized) state is conceptualized as a case where a manufacturer simply offers a product to an existing end-user market segment and where the product addresses a particular buyer's need through its functionality. The firm's offering consists of only the product and the manufacturer is deemed as a non-servitizing firm.

In the first approach to servitization (*Product and Services*), the manufacturer continues to offer the same product as in the initial state but adds related (complementary) or even unrelated (additional) service elements to the firm's offering. Thus, the firm's offering is differentiated from its initial state by its extension through additional offering elements. These additional offering elements may be targeting the firm's existing customer market segment, yet they are not restricted to do so. Additionally, by default, these offering elements must address a different need than the one satisfied by the product-offering. Thus, it is argued that this extension of the firm's offering corresponds with the concept of product market diversification, as the firm brings a new-to-the-firm offering element that is different from its initial product-offering.

In the second approach to servitization, (*Product with Services*), the manufacturer bundles, combines, or otherwise enhances the product-offering but adds no additional discrete elements to the firm's offering. Thus, the firm's offering is differentiated from its initial state by the transformation of the original product-offering. This enhanced new offering again may be targeting the firm's previous customer yet it is not restricted to do so. Additionally, the new offering may satisfy the same need previously met by the product-offering (presumably in a better way) yet it is again not restricted to it. In this case, it is argued that this transformation of the product offering corresponds with the concept of product differentiation (that may or may not entail a product market diversification aspect), as the firm provides an improved or different version of the original offering.

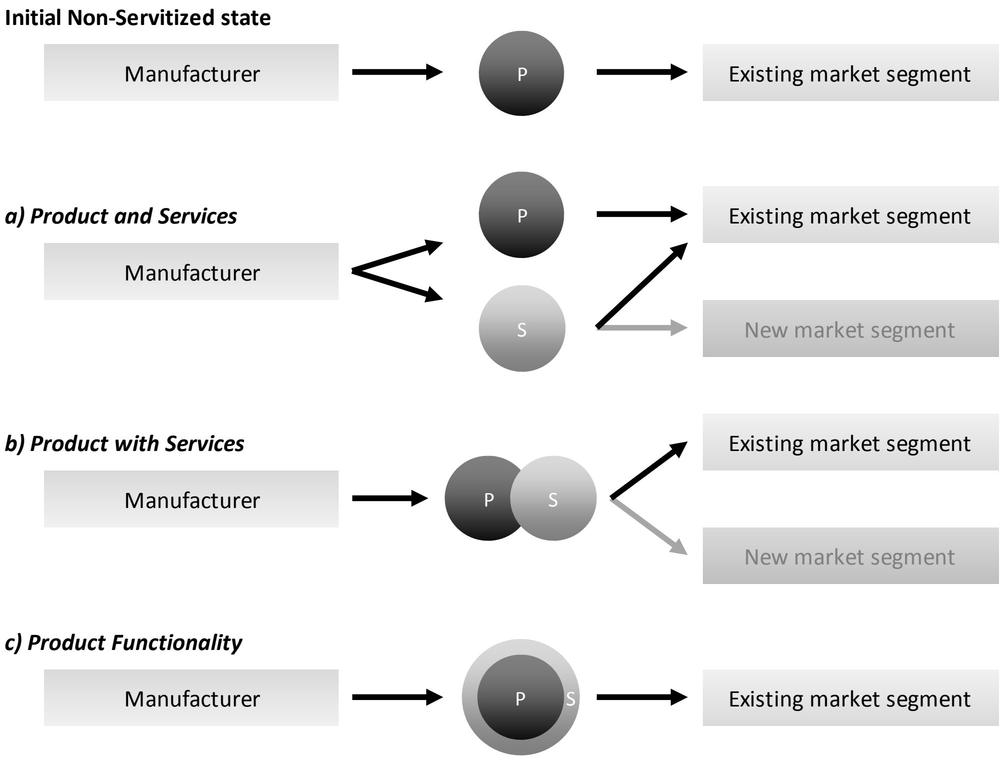


Figure 3-2. Abstract view of approaches to servitization

In the third approach to servitization, (*Product Functionality*), the manufacturer neither adds an additional offering element, nor improves the original product-offering. In fact, the original product is not offered at all. It is the functionality of the product that is offered. However, since the product itself does not change, the functionality offered must address the same need for which the product was originally intended. Therefore, it is held that differentiation (while present) does not stem either from product market diversification or product differentiation. Something else seems to be at work here. What is posited to change from the initial state is that the firm chooses to internalize a process that was previously performed outside of its boundaries. In order to assist the clarification of this premise, insights are drawn from Transaction Cost Economics (TCE).

At its bare bones, TCE's main goal is to explain why firms internalize (or perhaps externalize) certain transactions that could otherwise be performed in markets (Coase, 1937). Through a TCE perspective, the answer to the given question is offered by the observation that certain concessions notwithstanding (namely, bounded rationality, asymmetry of information and opportunism) firms will try to achieve the most efficient governance form given a transaction embedded in a specific economic context (Williamson, 1975; Amit and Zott, 2001, p.499). In clarifying the meaning of the term transaction in this context, reference is made to Williamson's

(1983) view of it, as the transference of a product or service across a technologically separable interface. Though this definition was originally aimed to emphasize transactions between processing or assembly stages within a manufacturing setting (Williamson, 1983, p.104), it is assumed that within the broader TCE framework it may also be held to include the transference of a product or service between economic entities (i.e. firms).

Returning, to the interpretation of the third approach, in the initial (non-servitized) state, the manufacturer produces a product and conducts a transaction by transferring that product across firm boundaries to the customer. However, given Vandermerwe and Rada's (1988, p.315) 'total complementarity' proposition between products and services, in which all products may produce services (through their functionality), this transference of products between firms effectively also transfers the services that may be rendered by those products. As such, it is put forth that the firm differentiates by changing the governance form of the transference of the services produced by its products. In other words, the firm differentiates by internalizing the transaction of services that was previously performed externally (to the firm's boundaries) by the transference of products.

In summary, by utilizing an abstract conceptualization and drawing from strategy and industrial organization theory, it is forwarded that the three approaches to servitization identified in the review of the literature, generate differentiation in three distinct ways: market diversification, product differentiation and transaction governance modification. The *Product and Services* approach is found to yield differentiation primarily through market diversification. The *Product with Services* approach is found to lead to differentiation principally through product differentiation (although without excluding market diversification). Finally, *Product Functionality* is found to master differentiation through transaction governance modification.

A key point to this interpretation of the three approaches to servitization is that, while all three present a form of servitization, they do not necessarily lead to the same or even similar final state. Additionally, the underlying strategy driving each approach may also be decidedly different. As such, it is posited that there is no singular equifinality to which servitizing manufacturers can (or even should) aspire to and that there is no singular strategy to the pursuit of servitization. To underline the important implications of this interpretation, the tenets of contingency theory (Hofer, 1975; Donaldson, 1996) and the resource based view of the firm (Wernerfelt, 1984; Barney, 1991) are employed.

As contingency theory informs us, no optimal strategy exists for all firms. To the contrary, the optimal strategy available to each firm depends on contextually contingent factors (Donaldson, 1996) that are furthermore industry dependent (Porter, 1985). Therefore, it should be expected that different firms operating in different industries will apply different (or even the same) approaches to servitization in different ways. This contingent view of the various approaches to servitization, of course, does not necessarily exclude their mutual pursuit. As with all business strategies, a firm may -theoretically as well as practically- undertake them separately, consecutively or even concurrently depending on contextual contingencies and managerial choice.

Additionally, when utilizing the lens of the resource-based view of the firm, it is clear that the pursuit of a particular approach to servitization will, most probably, mobilize and dedicate different firm resources to different operational objectives had another approach to servitization been elected. Indeed, as Hitt and Ireland (1986) have shown, different (product and market) diversification strategies require different corporate level distinctive competencies. Finally, when taking into consideration the dynamic capabilities perspective (Teece et al., 1997; Eisenhardt and Martin, 2000), it is further put forth that the pursuit of a specific approach, or the pursuit of a particular combination of approaches to servitization will inevitably lead to the development of discrete firm capabilities (dynamic and otherwise). Corollary to this is that the firm would then be placed on a particular (path-dependent) trajectory, on the course of which some opportunities for further development may or may not be suitable, applicable or even desirable.

Given these insights, it is put forth that the differing notions of servitization identified in the study potentially represent significantly different approaches aiming at competitive advantage and value through dissimilar differentiation strategies. Thus, it is held that they merit individual or at least contingent study.

3.4 A reframing of the servitization concept

In this section, a reframing of the servitization concept is an attempted. The conceptual analysis and interpretation of the three approaches to servitization, identified in the literature, posited that there are three underlying mechanisms (based on the broader concept of differentiation) that drive competitive advantage and value creation in each case. These mechanisms were recognized to be: market diversification, product differentiation and transaction governance modification.

In identifying these mechanisms through an abstract model that included a manufacturer, an offering and targeted customers, the complex realities of the business world were conveniently simplified. Thus, the intricacies of supply chains containing multiple and diverse distribution networks and delivery channels where neglected. While this may be of no significant consequence to the higher order of abstraction present in the strategy concepts of product differentiation and market diversification, it is held that the same does not apply to the rather specific concept of transaction governance modification. To remedy this inefficiency, it is deemed necessary to widen the scope of the abstract conceptualization of servitization by further including the structure of transactions in addition to the governance of transactions. In this way, intermediaries between the manufacturer and the customer are also taken into consideration.

In adopting the term transaction structure and combining it with the notion of transaction governance the study is aligned with Amit and Zott (2001) who provide the following definitions for the terms: “Transaction structure refers to the parties that participate in the exchange and the ways in which these parties are linked(…) [as well as to] the adopted exchange mechanism. (…) transaction governance refers to the ways in which flows of information, resources and goods are controlled by the relevant parties” (Amit and Zott, 2001, p.511).

Having sufficiently conceptualized the three posited sources of competitive differentiation in each of the three approaches to servitization, their potential interrelatedness is now investigated so as to parsimoniously advance the reframing effort. The concepts of product differentiation and market diversification are first examined. While acknowledging the inherent conceptual differences between these strategies, it is also acknowledged that there is a complementary relationship between. For instance, as a differentiated product may address the needs of the same or a different target customer, it may lead to market diversification (through accessing different customers). As such, the conceptual links between them depend upon the intended target customer of a differentiated product and the definition of what constitutes market diversification. Given this interrelationship, it is forwarded that both of these concepts represent competitive strategies sufficiently encompassed in received notions of the concept of product market strategy.

Zott and Amit (2008, p.3) view product market strategy as “the way in which a firm chooses to position itself against competitors in its addressable market spaces” and cite price, quality, timing as well as served customer segments, geographic markets and product offerings as aspects of product market strategy. In adopting the same view, it is recognized that both product differentiation and market diversification are strategies related to the positioning of the firm within its ecology in terms of product offerings and addressable markets. It is argued, however, that the same cannot be said about strategies seeking to modify the structure and governance of transactions. It is received that this approach does not necessarily imply a change in the product market positioning strategy. While equally posited to be leading to competitive differentiation, it is forwarded that modifying the structure and governance of transactions aims at the reconfiguration of relationships, incentives and responsibilities primarily within a given product market positioning. Thus, it is proposed that transaction structure and governance modification should be held as a conceptually independent (i.e. orthogonal) notion from the concept of product market positioning (Figure 3-3).

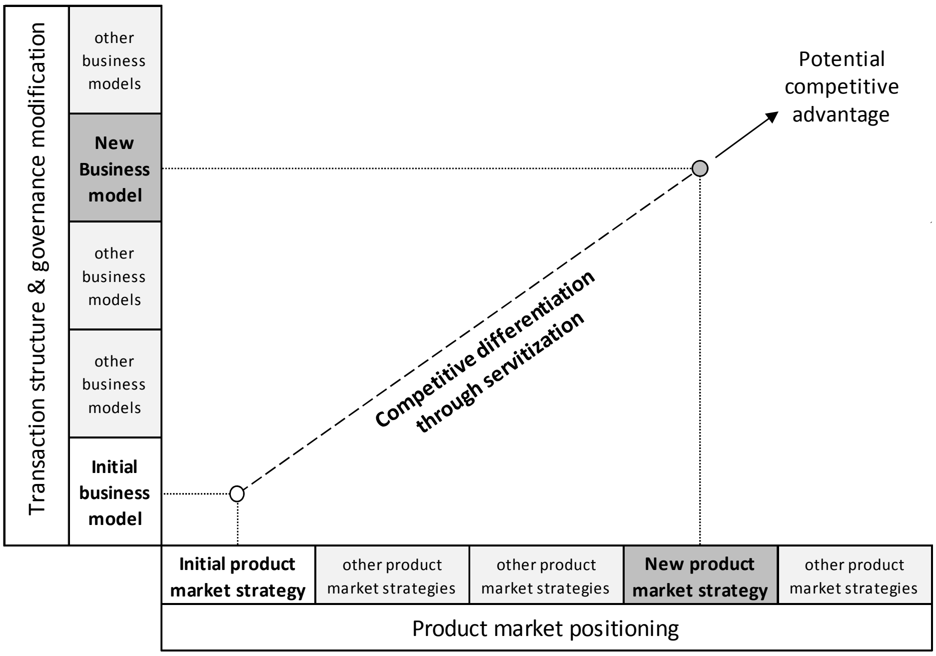


Figure 3-3. Servitization approaches to competitive differentiation

The latter proposition, as well as the distinctiveness of these concepts, may be particularly illustrated when viewing transaction structure and transaction governance as constituent elements of the business model construct (Amit and Zott, 2001). Christensen (2001) argues that the business model can be a source of competitive advantage that is distinct from the firm’s product market position, while Zott and Amit (2008) present theoretical as well as empirical evidence to the same end and further recognize a complementary relationship between the two concepts in terms of value creation. Thus, product market positioning and transaction structure and governance modification are held to be two orthogonally situated yet complementary strategies. Consequently, it is proposed that the various and multifaceted approaches to servitization may be sufficiently viewed, situated and contingently studied through the perspectives of product market positioning and transaction structure and governance modification.

Based on the preceding discussion, the reframing effort is advanced and servitization is held to represent (or underlie) the pursuit of these two distinct yet complementary (in terms of value creation) competitive differentiation strategies. Thus, it is forwarded that servitization may be viewed to represent:

> *A competitive differentiation strategy that may entail the consecutive, sequential or concurrent pursuit of product market repositioning and transaction structure and governance modification*.

To facilitate the contextual study of servitization on the basis of these two perspectives, as well as contribute to the formation of a shared terminology, the following terms are put forth: 'transformational servitization' to denote servitization efforts attempting to create value and competitive advantage through product market (re)positioning strategies, and 'transactional servitization' to denote efforts pursuing value creation and competitive advantage through transaction structure and governance modification strategies (Figure 3-4).

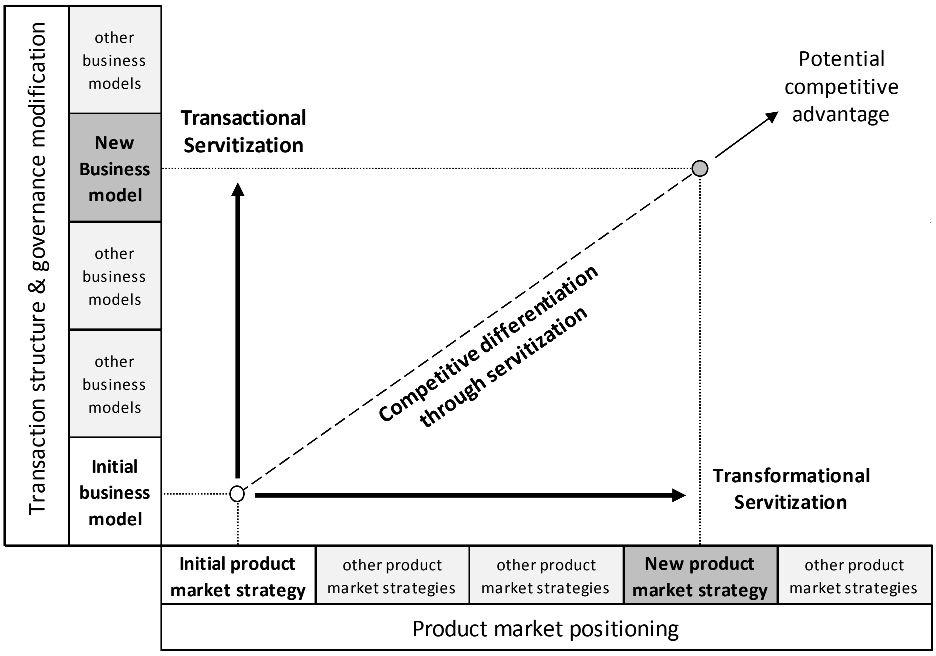


Figure 3-4. 'Transformational' and 'Transactional' approaches to servitization

The term 'transformational' is suggested in the sense that the firm transforms the contents (or the constituting elements) of its corporate offerings and/or even itself by repositioning within the broader business ecology. The term 'transactional' is suggested to represent the notion that the firm servitizes the transaction itself by modifying its structure and governance mode. On an ending note of caution, it is stressed that the term transactional is not to be construed with received notions of transactional and relational types of supplier relationships (as in Oliva and Kallenberg, 2003).

3.4.1 Transformational Servitization

Transformational servitization is held to represent servitization initiatives whereby a manufacturing firm seeks to gain competitive advantage and growth through the pursuit of alternative product market strategies. Said alternative product market strategies may include the transformation of the firm’s corporate offerings through services (in any way, shape or form) so as to address new customer segments (or new existing-customer needs) or even the transformation of the firm itself so as to be positioned within a different business ecology (i.e. a different industrial sector). An example of this type of servitization is offered by IBM’s transformation from a computer manufacturer into an information technology consultancy firm, a process naturally accompanied by the transformation of the firm’s corporate offerings from technological artefacts to services.

3.4.2 Transactional Servitization

Transactional servitization is held to represent servitization initiatives whereby a manufacturing firm seeks to gain competitive advantage and growth through the pursuit of alternative business models within its existing product market strategy. Said alternative business models are held to only address the firm’s existing customer needs and involve the modification of the structure and governance modes of the firm’s transactions with its customers. Examples of this type of servitization are offered in the form of performance-based or availability contracts (e.g. Rolls Royce’s Power-by-the-hour offering). Alternatively, this type of servitization may be held to refer to a manufacturing firm switching from ‘box-pushing’ business model paradigms to some form of ‘availability/leasing’ business model paradigms, always within its original product market segment. This last type of servitization is the focal phenomenon of interest in the present study.

Chapter 4

Transactional Servitization as a firm boundary decision

4.1 Introduction

Having offered a delineated and more nuanced view of servitization in the previous chapter, the study's particular phenomenon of interest, namely performance-based contracts, is put into focus. In this chapter, the nature of performance-based contracts is examined with the scope of uncovering the basic premises that allow for their successful implementation in a given industrial context. Primarily, performance-based contracts are identified as a form of transactional servitization attempted by a manufacturer. Subsequently, it is recognized that their successful implementation depends on the potential customer's inclination to outsource a series of activities that are traditionally performed by the customer. As such, the decision, on behalf of the customer, on whether or not to outsource the aforementioned activities is found to be at the heart of a performance-based contract's premise for success. Given that apprehension, focus is then put on the customer's dilemma by initially delineating the academic nomenclature that surrounds it and subsequently by exploring the significance and implications of the customer's available alternative choices.

4.2 Performance-based contracts: A form of transactional servitization

In this section, it is primarily argued that performance-based contracts for traditionally sourced industrial goods constitute a form of 'transactional servitization' or otherwise a form of transaction structure and governance modifying approach to servitization. Otherwise known as Performance-Based Logistics (PBL) initiatives (Kim et al., 2007), these offerings are posited to embody the pursuit of a competitive differentiation strategy through transaction structure and governance modification.

Support for this supposition is provided by Spring and Araujo (2009). The authors put forward that Performance Based Logistics (PBL) approaches primarily focus "on the shift in incentives and re-allocation of risk between the supplier and the customer" rather than on delivering complex products through systems selling and systems integration (Spring and Araujo, 2009, p.454-5). In the aforementioned line of argumentation, it is recognized that systems integration (Davies, 2003; 2004) and systems selling (Mattsson, 1973) predominantly refer to product differentiation strategies.

4.2.1 Historical development of performance-based contracts

The emergence and wider use of performance-based contract initiatives in a manufacturing context may be traced to the late 1990s and contextually situated within both a business-to-business and a business-to-government setting (Sols et al., 2008). In a business-to-business context, the paradigm may be posited to have taken a more consolidated form through the works of The International Society of Logistics (SOLE) in performance-based supportability (Rogers, 1997). The concept of performance-based supportability (PBS) reflected an effort on behalf of logistics professionals and practitioners to systematically consolidate and organize various observed best practices in the support of highly capital intensive systems with long operational life-cycles in domains such as transportation, aerospace and telecommunications infrastructure (Sols et al., 2007).

In a business-to government context, the use of performance-based contracts may be viewed to have originated from initiatives of the U.S. Department of Defence (DoD) aiming at the restructuring of supplier selection procedures in order to maximize the operational effectiveness of military systems (Kim et al., 2007). Accordingly, an indirect definition of performance-based contracts is provided in Kim et al. (2007) who in citing the U.S. Defence Acquisition University note that:

> “The essence of Performance Based Logistics [i.e. contracts] is buying performance outcomes, not the individual parts and repair actions (…) Instead of buying set levels of spares, repairs, tools, and data, the new focus is on buying a predetermined level of availability to meet the [customer’s] objectives”.

In this specific context, the PBL paradigm has been mandated as the de facto mode of operation for the acquisition of maintenance contracts since 2003 (U.S. Department of Defense, 2007). As stated in the ninth edition of the introductory guidebook of Defence Acquisition Management (Defense Acquisition University, 2009, p. 50):

> “PBL offers the best strategic approach for delivering required life cycle readiness, reliability, and ownership costs. Sources of support may be organic, commercial, or a combination, with the primary focus on optimizing customer support, weapon system availability, and reduced ownership costs.”

4.2.2 The assumption of customer demand and the need to lift it

Both of the aforementioned specific contextual environments that gave rise to the use of performance-based contract initiatives, in spite of their differing operational background, share a key common characteristic. The drive behind the implementation of a PBL approach to the procurement of maintenance or availability principally derives from customer demand. In the case of the U.S. Department of Defence this is evidenced by the mandated status of performance-based contracts, while in a business-to-business context it is illustrated by the customer’s demand for sustainable operational performance throughout the related capital intensive system’s lifecycle (Sols et al., 2007). Accordingly, most studies conducted in the field, take customer-driven demand as a given assumption and attempt to optimize the structure of performance-based contracts under various operational conditions (e.g. Kim et al., 2007; Nowicki et al., 2008; Sols et al., 2008)

Nevertheless, for a manufacturer seeking to servitize a traditionally sourced industrial good through performance-based contracts in other settings, the aforementioned optimization perspective is of little significance. When a manufacturer not operating in the aforementioned contexts, where performance procurement has been customer-driven, promotes its offerings in the form of performance-based contracts, potential customers may or may not choose to favour this new form of offering. Consequently, as customer willingness to engage in such a manner remains uncertain, so does the successful implementation of the servitization initiative. Therefore, it is posited that in such settings, it would be profitable to lift the customer demand assumption and to explore the strategic factors that influence an industrial customer’s propensity to accept servitized capital equipment offerings.

4.3 Performance-based contracts require the customer to outsource

In this section, the transactional servitization of manufacturing phenomenon through performance-based contracts is approached through the end-user's (customer's) perspective and the focal area of the research is identified. Summarily, it is maintained that the reception of such offerings for traditionally sourced industrial products constitutes, in principle, a form of activities outsourcing on behalf of the customer. Furthermore, in adopting a transaction governance perspective (Williamson, 1998), it is held that the reception of such long-term contracts is essentially an outsourcing endeavour within a hybrid/intermediate (Barney, 1999) governance mode situated between the alternatives of spot market and hierarchical types of exchange governance. To better conceptualise the aforementioned suppositions, the following theoretical analysis is offered.

Supposing a firm operating in a given business environment, that firm may identify a particular need akin to its business activities that needs to be satisfied. Further supposing that the need may be satisfied by the functionality of a known-to-the-world and mature (as opposed to a novel and disruptive) technological artefact (Figure 4-1), the firm must decide on the way with which this functionality is to be accessed, utilized and maintained so as to satisfy the need in a sustainable manner.

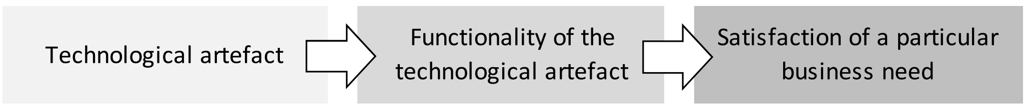


Figure 4-1. Addressing a business need through a technological artefact

Accessing the functionality pertains to the issue of somehow gaining control of, or access to, such a technological artefact. Utilizing the functionality pertains to the issue of somehow exploiting the artefact to the satisfaction of the identified need. Maintaining the functionality pertains to the issue of ensuring that the functionality remains accessible and available to the satisfaction of the identified need in accordance with the need's specifications (Figure 4-2).

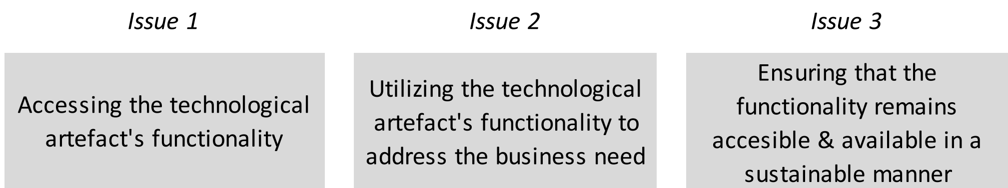


Figure 4-2. Basic issues pertinent to the satisfaction of a business need

In congruence with Williamson's (1998) view of industrial organization it is argued that given managerial choice all of these three issues may be chosen to be addressed through activities and transactions performed either within or outside of the boundaries of the firm. When performed within the boundaries of the firm, a hierarchical governance mode is said to be utilized. If elected to be performed outside of the bounds of the firm they may be chosen to be performed in either one of two ways: in a market governance mode meaning through arm's length agreements performed in a spot market, or in a hybrid/intermediate governance mode through more structured and long-term agreements performed with select suppliers (Figure 4-3). It should be noted that the aforementioned classification is in further accordance with the one put forth by Toffel (2008) in his study on contracting practices in a servitized setting.

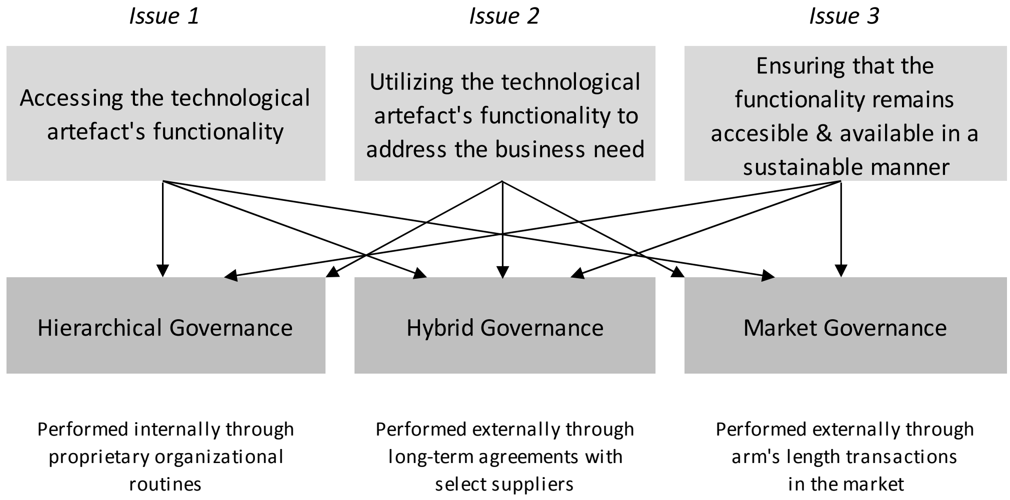


Figure 4-3. Governance modes of activities needed for the three basic issues

In the case where the firm elects an entirely autonomous approach to these issues, all relevant activities and transactions are performed internally. The artefact's functionality is accessed through the research, development and manufacturing of the artefact. Subsequently, the functionality is utilized through the use of the artefact in appropriate ways, while the functionality's maintenance is addressed through the servicing and repair of the artefact (or by its replacement by another artefact) that ensures the same functionality. To satisfy all of the aforementioned functions, the firm must thus develop and coordinate several sets of activities each pertaining to the effective and efficient fulfilment of each respective issue.

Due to various reasons though, as mentioned before, the firm may decide a less autonomous approach where the aforementioned issues are not entirely addressed within the boundaries of the firm. In accordance with Harrigan (1985) as well as Gilley and Rasheed (2000) it is recognized that the decision to somehow address these issues externally to the firm's boundary limits, by assigning the activities and transactions related to them to external economic entities, falls within the notion of outsourcing.

The most basic (or traditionally established) outsourcing decision primarily concerns the access of functionality issue. In particular, when the focal firm operates in business segments that are detached from the technological artefact's manufacturing segment, it is most frequently the case that the functionality access issue is approached through the procurement of the artefact from other firms that have already researched, developed and manufactured them. This basic outsourcing of the access issue is argued to reflect a traditional approach to the sourcing of industrial products. Furthermore, the particular approach is held to reflect the basis on which a manufacturer offers an industrial product to potential end-users in a non-servitized state. Consequently, this paradigm of goods procurement is further utilized as the starting point for the study's exploration of the servitization of manufacturing, through the end-user's (i.e. customer's) perspective.

Given that the access of functionality issue is addressed through the procurement of the industrial product, the focal end-user firm must then decide on a supplier for the artefact as well as address the functionality utilization and maintenance issues. Thus, the firm must decide from whom to acquire the artefact, how best to exploit the functionality offered and, finally, how the functionality's availability is to be ensured in a sustainable manner (given that the identified need is a continuous requirement, while the artefact's lifecycle is finite). In again supposing an autonomous approach, as traditionally is the case, the focal firm still develops and coordinates several sets of activities and transactions internally, each pertaining to the fulfilment of the remaining two basic issues.

At this point, it is argued that the offering of a performance-based contract for the technological artefact, seeks by definition to change the paradigm of internally developing the activities needed to address the remaining two basic issues. This is attempted by soliciting the performance of said activities and promising the sustained access, exploitation and availability of the artefact's functionality to the satisfaction of the identified business need. Thus, it is argued that the reception of the performance-based contract entails the outsourcing of activities previously developed (or at least handled) by the customer internally. However, apart from entailing the outsourcing of the activities in a general sense, it is further held that such a contract (also by definition) seeks to ensure that the activities are: (1) outsourced in a particular form of governance, namely a hybrid governance mode (Figure 4-4) as well as (2) outsourced to a particular supplier firm, i.e. the firm offering the contract.

Hence, it is proposed that the study of factors that affect an end user's willingness or propensity to employ an outsourcing governance mode to address the activities and transactions related to the three primary issues that that were previously performed internally, constitutes a focal research area that reflects the study of factors affecting the successful implementation of a transactional servitization strategy in the form of performance-based contracts.

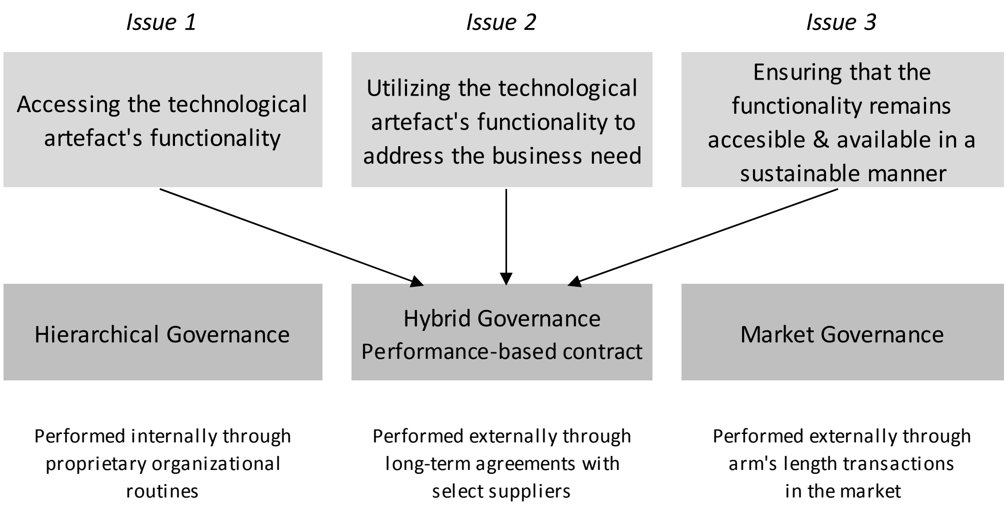


Figure 4-4. Governance mode advocated by performance-based contracts

4.4 The customer's dilemma: A make-or-buy or firm boundary decision

As evidenced in the previous section, the acceptance of performance-based contracts, on behalf of the customer, entails the outsourcing of a number of activities previously performed within the bounds of the customer firm. As such, it is put forth that when a customer firm is presented with such an offering, it is essentially faced with a classic make-or-buy or otherwise a firm boundary decision. That is to say that when a manufacturer proposes a performance-based contract to a potential customer, that customer has to decide on whether the associated activities are better left to be performed within the bounds of the firm (as they have traditionally been) or whether they should be outsourced to the manufacturer and thus performed outside of the bounds of the firm. Hence, it can be argued that the customer is faced with a firm boundary changing dilemma.

The firm boundary problem, otherwise known as the make-or-buy decision in a manufacturing context and perhaps appropriately paraphrased as the perform-or-buy decision in service related contexts, is the issue of determining whether a firm should make a component or perform an activity within its hierarchical boundaries or somehow procure it from an outside source.

In a manufacturing context, the make-or-buy decision relates to a manufacturer's choice of whether to internally produce a given component of one of its products or to procure it from an external (OEM) manufacturer. In a services related context, the perform-or-buy decision relates to a firm's choice on whether to internally perform an activity that renders a useful service, or to procure the service from an external provider. In reality, in both manufacturing as well as service contexts, the focal firm determines whether it wants to perform certain activities internally or not. In the first case, it relates to activities that lead to the production of a good, while in the second case, it relates to activities that lead to the rendering of a service. As such, in both cases the related decision can parsimoniously be regarded as a firm boundary decision or a firm boundary related problem.

More neutrally, the firm boundary issue is also regarded as the insourcing/outsourcing problem, where in exactly the same way a focal firm is called to determine whether it should insource or outsource an activity leading to the production of a physical good or the rendering of a service. Similarly, yet in a more confined way the firm boundary issue has also been referred upon as the vertical integration or disintegration issue, where focus is put on the insourcing or outsourcing of vertically (or value chain) linked activities. In any case, in the interest of parsimony, these instances are again regarded as firm boundary decisions.

On a final note, of interest to the characterization of firm boundary decisions as sourcing decisions is the distinction between the a priori and a posteriori insourcing/outsourcing of an activity. When the sourcing decision is made prior to a firm's establishment (e.g. in the business plan phase), then it may be referred as an abstention-based insourcing/outsourcing decision, while when the decision is made in any other instance of a firm's lifecycle, it may be referred as a substitution-based sourcing decision (Gilley and Rasheed, 2000; Holcomb and Hitt, 2007).

No matter what the nomenclature is, the point remains that when an end-user of an industrial good is faced with the offering of a performance-based contract for it, the acceptance or rejection of the offering will depend on the customer's decision on whether or not to outsource the activities that are tied along with it.

4.5 The importance of the customer's firm boundary decision

In this section, focus is put on the significance and implications of the customer's firm boundary decision, that is the decision to insource or outsource the activities associated with a particular performance-based contract.

The significance of this decision, as far as the servitizing manufacturer is concerned, cannot be overstated as it is found at the crux of whether a performance-based contract offering will be accepted or rejected by the customer. In other words, for the manufacturer in the pursuit of transactional servitization, the customer's decision stands to applaud the manufacturer's initiative or doom it to failure. Nevertheless, given the fact that the customer is the ultimate decision-maker in the issue, any further investigation for additional implications on the side of the manufacturer is deemed unwarranted and outside the scope of this research. In contrast, it is the customer's side of things that merits a deeper and more nuanced inquiry.

In essence, what is asked here is: why is the firm-boundary decision important for the customer? Or otherwise: What difference does it make for the customer whether the related activities are insourced or outsourced? A simple answer to these questions is that the decision will inevitably influence the current state as well as future development of the customer-firm as each choice opens up certain opportunities while simultaneously shutting down others. In order to more thoroughly investigate the implications of each choice a simple short-term vs. mid to long-term schema will be utilized.

4.5.1 Implications of insourcing the related activities

Primarily, focus is put on the implications of insourcing the activities associated with the performance-based contract, or otherwise maintaining the status quo in traditionally sourced industrial goods. In this case, the customer firm rejects the offering and maintains the activities within the bounds of the firm.

In a short-term analysis, the choice may be deemed beneficial to the customer firm to the extent that the cost of conducting the activities in-house is not higher than the cost of outsourcing and procuring the activities by the servitizing manufacturer making the offer. If, on the other hand, the overhead and other costs associated with keeping the activities in-house is higher than the performance-based contract's cost, then it can be said that the customer firm is erroneously foregoing a potentially profitable outcome. In short, given that a non-trivial price differential exists between the two choices, then the decision to insource might result to an unchanged or potentially forgone better bottom-line.

In a medium to long-term analysis, the choice to insource the activities means a number of things, depending on one's strategic outlook. From a dependence/autonomy perspective, for example, the decision leads to autonomy from outside suppliers which may be beneficial in the case of an oligopolistic market environment. By the same token, however, the insourcing firm may run the risk of isolating itself from a potentially beneficial competitive environment that could lead to further efficiency gains.

In parallel, the decision to keep the relevant activities in-house might be a potential opportunity for future growth for the company if it manages to perform them more efficiently than competitors or aspiring suppliers. In that case, the firm could eventually offer its services to competitors or other interested parties and, thus, generate an additional revenue stream. Similarly to the downsides of autonomy, however, if the firm performs the activities at a subpar level when compared to competitors or suppliers, the decision means that capital and resources are held up in a non-productive endeavour.

Finally, if the relevant activities can be deemed part of the firm's goodwill or otherwise good brand name in the market, or if they can be found to be in congruence to the management's vision for the company (irrespective of their current efficiency), then the choice to insource or keep them in-house may be viewed in a positive light. If none of the above apply or, worse, if the activities dilute the company's corporate identity and send the wrong message to its customer base, then the choice might be considered as move towards a precarious direction.

4.5.2 Implications of outsourcing the related activities

Secondly, focus is put on the implications of outsourcing the activities associated with the performance-based contract. In this case, the customer firm accepts the offering and procures the activities from one or more outside suppliers while downsizing its own relevant capabilities.

In a short-term analysis, the choice may be deemed beneficial to the customer firm to the extent that the cost of conducting the activities in-house is higher than the cost of outsourcing and procuring the activities by the servitizing manufacturer making the offer. If, on the other hand, the tendering, procurement, coordination and other costs associated with outsourcing the activities is higher than the previously held in-house arrangement, then it can be said that the customer firm is erroneously embarking in a less efficient and potentially troubling situation. In short, given that a non-trivial price differential exists between the two choices, then the decision to outsource might result to a better or worse bottom-line.

In a medium to long-term analysis, the choice to outsource the activities may again be viewed to lead to a number of different outcomes, given the strategic perspective employed. From a dependence/autonomy perspective, first of all, the customer becomes dependent to its outside suppliers. This should not pose any significant problems so long as the suppliers are plentiful and competing against each other effectively while also being easily interchangeable. If they are not enough in numbers then oligopolistic trust behaviour may start eating away at the arrangement's earlier benefits. If they are not easily interchangeable, or if the customer firm is not able to benefit by the suppliers' competitive struggle, then there might really be little to no difference between having a long-standing and stable partner and having an internal department to handle the activities.

In terms of potential future growth, it may be said that the decision to outsource was a wise one if the customer firm had little or no hopes of ever being equal or better in performing the relevant activities when compared to competitors and suppliers. In that case, capital and resources are freed up to be allocated in more productive endeavours. If the contrary is true, then future growth opportunities were wasted.

Finally, if the relevant activities were deemed part of the firm's good brand name or goodwill in the market that helped reinforce its corporate image and identity, outsourcing them may be a serious mistake. If, on the other hand, the activities had only a minor or no role to play with regard to the company's reputation then outsourcing them would make no difference with regard to this strategic perspective.

4.5.3 Concluding remarks on the firm boundary decision

From the previous abbreviated analyses, two points become evidenced rather clearly: First, that the decision can have profound implications for the future development of the customer firm and, second, that the prudent choice seems to depend on a series of contextual factors that only come into light when different strategic perspectives are employed.

To better illustrate the second point, if the strategic perspective kept only current or short-term efficiency in mind, then the choice would be left to a laconic cost/benefit analysis of yearly expenditures. If on the other hand, autonomy is held as a strategic imperative, then the suppliers' business environment and future market trends come into focus. If future growth opportunities are taken into account, then the deciding company is urged to look both at its own strengths and capabilities as well as the ones of its competitors and hopeful suppliers.

In short, there is a variety of strategic considerations that may be held to influence the customer's firm boundary dilemma and consequently the successful or valueless implementation of performance-based contracts on behalf of manufacturers. A number of such considerations, most prominently featured in the outsourcing/firm boundary literature, is the basic premise of the following chapter.

Chapter 5

Strategic Considerations affecting Customer Firm Boundary Decisions

5.1 Introduction

In the previous chapter, it was demonstrated that the successful implementation of transactional servitization, through performance-based contracts, is largely dependent on the potential customer's volition to accommodate a series of firm-boundary changes required by the contract offerings. In parallel, it was underlined that these firm-boundary changes constitute a series of make-or-buy or firm boundary decisions that the customer has to make in the process of accepting or rejecting a given performance-based contract.

Furthermore, in the concluding sections of the previous chapter, reference was made to the importance and implications of the aforementioned firm boundary decisions to the customer firm. Within that brief description of the potential outcomes of the decision to outsource or to keep the relevant activities within the bounds of the firm, it was evidenced that different strategic perspectives lead to different strategic considerations and, ultimately, to the deliberation of different contextual factors in the search of a prudent course of action.

This chapter offers a literature review and conceptual analysis of four particular strategic perspectives through which the customer firm's boundary dilemma is explored. The chapter begins with a general recounting of the relevant literature and subsequently focuses on the articulation of each strategic perspective through a particular theoretical framework. Each theoretical framework's assumptions, conceptual rationale and associated sourcing state discriminating hypotheses are then delineated while any novel assertions or complementary hypotheses are offered during the discussion of each respective framework.

5.2 Strategic perspectives of firm boundary decisions in the literature

The purpose of this section is to summarily report on some of the principle strategic perspectives that inform the examination of firm boundary decisions in the strategy literature, and particularly as they pertain to the internal development or external procurement of an activity or resource. Given that the relevant literature is vast, to say the least, while the resources available to this study are limited, the first step in identifying these perspectives was the search for previous studies addressing the issue. Such an informative and holistic study is provided by Santos and Eisenhardt (2005).

In their study, the authors summarize and collectively report on the main strategic perspectives that relate to the examination of firm-boundary phenomena and further offer a useful way of treating them as conceptions of organizational boundaries. As such, Santos and Eisenhardt (2005) recognize four principle strategic perspectives, or otherwise strategic logics, that may meaningfully inform the investigation of firm-boundary decisions. These are:

- The efficiency (cost minded) perspective
- The dependency (autonomy minded) perspective
- The competence (competitive advantage minded) perspective
- The identity (coherence minded) perspective

Informed by Santos and Eisenhardt's (2005) work, the present study supplements the scope of the report with a summative review of more contemporary literature pertaining to the various designations of the phenomenon along the aforementioned strategy logics. To that end, terms such as *make-or-buy*, *outsourcing*, *vertical integration*, and the like, where utilized as lead indicators for the identification of research attempting to investigate and explain firm boundary decisions. This supplemental review does not attempt, nor pretends to be, an exhaustive review of firm boundary literature. It simply seeks to complement the groundwork provided by Santos and Eisenhardt (2005) and provide further contextual clarity as to the state-of-the-art in firm boundary theory.

5.2.1 An overview of the efficiency perspective

How firms should draw their boundaries has been a fundamental question in strategy since the better part of the previous century. Primarily tackled in the fields of industrial organization economics (Coase, 1937), and law, thanks to a series of high-profile anti-trust actions (Cross, 1953), the issue was finally inherited to the strategic management field by the 1960s. In management practice, the issue enjoyed various periods of prominence that fluctuated with the prevailing economic and business conditions. In its outsourcing manifestation, the issue re-emerged in the 1990s and climaxed in the globalization climate of the 2000s as offshore outsourcing.

For more than thirty years, the prevailing framework used to explain and predict firm boundary decisions through an efficiency-based strategic perspective, has been Williamson's (1975, 1981) Transaction Cost Economics (TCE) framework and related exchange-efficiency perspectives (Poppo and Zenger, 1998; Santos and Eisenhardt, 2005). These frameworks underline the importance of cost minimization when considering firm boundary changes and deliberate a considerable number of potentially cost-inducing factors. Recent literature analyses and reviews, however, seem to disagree on whether there is strong or mixed evidence to support the tenets of TCE.

For example, David and Han (2004) perform a tabulative analysis of past research based on TCE and argue that there is mixed empirical support for the theory's principles. Geyskens, Steenkamp and Kumar (2006) on the other hand, based on meta-analytic techniques, quantitatively synthesize and evaluate previous empirical research on organizational boundaries and find strong support for the theory. Concurrently, Carter and Hodgson (2006) critically review a number of prominent TCE based empirical studies and argue that few studies provide unambiguous support to the core tenets of TCE as formulated by Williamson.

Nevertheless, David and Han (2004) point out that there is considerable ambiguity (or even disagreement) on the operationalization of some of TCE's central constructs and propositions while Carter and Hodgson (2006) identify no less than three different Transaction Cost-based branches within the general TCE paradigm. Furthermore, Carter and Hodgson (2006) recognize that a sizable amount of the vertical integration studies that they assessed contained elements of competence or resource-based perspectives that could potentially confound the evidence of support for TCE's propositions. Consequently, they argue for more clearly delineated empirical studies while proposing that the integration of TCE and competence-based perspectives would be the most productive area of development in investigating firm boundary decisions.

5.2.2 An overview of the competence perspective

The previous section's last proposition effortlessly directs the discussion to the second family of strategic considerations that has been utilized to explore vertical integration (or disintegration) decisions. This growth or competitive advantage minded perspective has been collectively referred upon as the Resource-Based View (RBV) of the firm. In a few words, this perspective stresses the importance of formulating a competitive advantage generating firm configuration when considering firm boundary changes.

Ever since, Prahalad and Hamel's (1990) business review and Barney's (1991) seminal yet arguably limitedly refined paper on sustained competitive advantage, Penrose's (1959) and Wernerfelt's (1984) work on heterogeneity induced resource-based advantages, has gained unprecedented prominence in organizational literature. In its twenty-five odd year development, and in a fashion similar to TCE, the RBV perspective has evolved in primarily two schools of thought.

The first has been referred upon as traditional or static RBV (Newbert, 2007). This school of thought originated from Barney's (1991) initial Value, Rareness, Inimitability and Non-substitutability (VRIN) based framework for the assessment of firm resources. Throughout its development, it has largely evolved into an efficiency based perspective emphasizing the relationship of a resource's value and rareness (in the form of scarcity) with the generation of rents and bottom-line performance (Peteraf and barney, 2003). An informed review and assessment of the critiques of traditional RBV is provided by Kraaijenbrink, Spender and Goren (2010) while a useful meta-analysis of its core tenets is offered by Crook et al. (2008).

The second school of thought, referred sometimes as dynamic RBV (Helfat and Peteraf, 2003; Armstrong and Shimizu, 2007), is more predominately known as Dynamic Capabilities Theory (DCT). Stemming from the early work of Nelson and Winter (1982) on organizational routines and primarily articulated by Teece, Pisano and Shuen (1997), the Dynamic Capabilities framework, emphasizes the management and learning related aspects of a firm's resource configurations. Further refined by Eisenhardt and Martin (2000), dynamic capabilities echo 'the organizational and strategic routines by which firms achieve new resource configurations' in changing markets. An informed review of DCT is offered by Barreto (2010).

The literature generally views these two schools of thought as frameworks representing different, albeit complementary, approaches seeking to explain firm performance. This dichotomy is evidenced by the diverging reviews offered by Kraaijenbrink et al. (2010) and Barreto (2010). Furthermore, in most cases the dynamic perspective is viewed as an extension of the static or traditional one (Newbert, 2007; Barreto, 2010). Despite this seemingly enduring separation, sufficient unifying attempts have been reported since at least the early 2000s. Hoopes, Madsen and Walker (2003) for example offer a decisive narrative explanation of the way by which the two frameworks may consistently be used to explain firm performance. Nevertheless, while Hoopes et al. (2003) provided the relational logic between the frameworks, it wasn't until Sirmon, Hitt and Ireland's (2007) attempt at the formulation of a unifying framework that a new combining research agenda started to take shape.

The aforementioned research programme, however, is still on-going and a commonly accepted formulation has yet to appear. Moreover, even in isolation the two diverging frameworks have been accused of being difficult to formalize due to the absence of specific behavioural assumptions as well as the imperfect observability of key resources (Lockett, Thompson and Morgenstern, 2009). Given that a common unifying formulation, with reasonably developed falsifiable conjectures remains elusive, this study acknowledges that the two perspectives offer conceptually as well as pragmatically, distinct insights towards the explanation of firm performance. As such, in this study they are treated largely as two separate yet complimentary theories with distinctively unique contributions in the academic discourse. Furthermore, focus is put only on one of them, namely the traditional or static branch and specific behavioural assumptions are developed where possible, so as to enable a more frugal application of the theory. Consequently, static or traditional RBV is referred simply as the RBV framework while any reference to dynamic RBV's assertions is attributed to Dynamic Capabilities Theory. Nevertheless, it must be recognized that this referential distinction may oftentimes be difficult to maintain when interpreting other authors' works, as some may treat or refer to the two approaches as a singular theoretical framework. Where such issues arise, relevant clarifications will be provided.

To the best of the author's critical ability, and as pointed out also by Armstrong and Shimizu (2007), a significant source of confusion in the RBV framework, is the meaning and definition of the term resource, which has been criticized as being 'all-inclusive' (Priem and Butler, 2001) as well as 'extremely expansive' (Denrell, Fang and Winter, 2003). Concerning this issue, it is pre-emptively noted that the present study utilizes Helfat and Peteraf's (2003) definition of the term resource as a tangible or intangible asset that a firm owns, controls or has access to and from which it potentially derives rents. The study further adopts Helfat and Peteraf's (2003) definition of the term competence as a configuration of resources that enables a firm to accomplish a particular task, a definition previously offered in Grant's (1991) business review paper. Further definitions and term demarcations are provided in their respectively relevant sections.

Notwithstanding the aforementioned perplexity caveats, RBV's and DCT's propositions have arguably offered invaluable insights in the organizational discourse. While predominantly occupied with the explanation of competitive advantage among firms, both the multi-faceted RBV as well as the DCT perspective have emerged as complementary or even competing frameworks, trying to explain firm boundary related decisions (Santos and Eisenhardt, 2005).

5.2.3 Combined efficiency-competence approaches

An early example of the complementary use of DCT in conjunction with TCE in explaining firm boundary decisions is presented by Leiblein and Miller (2003). In their study, the authors empirically test a model of vertical integration that contains a limited number of elements of TCE, DCT as well as Real Options Theory (ROT). They find that transaction- as well as firm-level characteristics play significant and largely independent roles in firm's vertical boundary decisions. Through the datasets employed, however, they are unable to identify the relative magnitude of each characteristic. Furthermore, they propose the inclusion of Resource Dependency Theory (RDT) in future studies.

Jacobides and Winter (2005) integrate TCE and DCT arguments and approach the issue of vertical scope from a systemic rather than micro-analytic point of view in an attempt at identifying the evolutionary mechanisms that determine vertical scope over time. The proposed conceptual framework emphasizes the interaction of capability differences among firms with transaction costs along the evolution of an industry's value chain. Additionally, they suggest that capability distributions are affected by knowledge base similarities along the value chain and managerial styles.

Mayer and Salomon (2006) utilise elements of TCE and capability-based RBV to investigate the impact of a focal firm's technological capabilities in the decision to outsource related activities in the face of varying levels of contractual hazards. By analysing data from a single firm's subcontracting record, they find that both perspectives significantly inform governance mode choices and, while noting several caveats, argue for the existence of a governance capability that may alleviate outsourcing hazards.

Following a similar contractual point of view, Barthélemy and Quélin (2006) analyse a series of outsourcing contracts through a TCE perspective while utilizing certain RBV arguments to determine the relative strategic importance of each outsourcing endeavour. In their contract contents analysis, they find evidence for TCE's validity and, in a fashion similar to Mayer and Salomon's (2006) governance capability, suggest that outsourcing experience may lead to further outsourcing initiatives. More intriguingly, they call for the consideration of trust and relational contracting, issues that echo Granovetter's (1985) Social Capital/Embeddedness perspective.

In the previously presented studies, RBV and DCT arguments are primarily used in a supplementary rather than complementary role in explaining firm boundary decisions. While this may be attributed to some extent to criticisms rendered on RBV literature concerning the lack of rigorous propositions and/or evidence of its predictive ability (Kraaijenbrink, Spender and Groen, 2010), RBV's academic discourse is progressing and headway towards more formalized and operationalized levels of the theory is being made. Two cases in point are offered by Holcomb and Hitt (2007) and McIvor (2009).

Holcomb and Hitt (2007), construct a conceptual model to explain strategic outsourcing by utilizing specific TCE, RBV, DCT as well as Social Capital/Embeddedness propositions in a more concise yet non-exhaustive manner. Drawing on their conceptual framework, they put forth a series of testable propositions concerning issues that may affect the likelihood by which a firm will pursue strategic outsourcing. While not providing any empirical evidence, of interest in this conceptual study is the inclusion of elements from a diverse portfolio of theoretical frameworks and the proposal of solid testable hypotheses.

McIvor (2009), focuses more explicitly on some key arguments put forth by TCE and RBV and drawing from a series of case studies and archival data formulates a prescriptive framework for the evaluation of outsourcing initiatives. The author elaborates on the implications of each framework's core tenets and outlines the cases where the models act in a complementary as well as contradictory manner. Though, non-exhaustive, the study focuses on the core issues of opportunism, strategic relatedness and capability position outlined by the TCE and RBV frameworks.

5.2.4 An overview of the dependency perspective

This strategic perspective, rather than focusing on efficiency or competence based considerations, stresses the importance of autonomy and self-reliance. As called for by Leiblein and Miller (2003), a theoretical framework that may meaningfully inform explanations of firm boundary decisions through the dependency perspective, is Resource Dependency Theory (RDT). First introduced by Pfeffer and Salancik (1978), RDT characterizes the firm as an organization operating in an open system and dependent on contingencies in the external environment. As such, RDT focuses on concepts such as mutual dependence and power imbalance to explain firm behaviour (Casciaro and Piskorski, 2005). While utilized extensively in explaining intrafirm phenomena such as executive succession and board of directors' size and composition, RDT remains a strong predictor of interfirm phenomena such as Mergers & Acquisitions (M&As) and Joint Ventures (JVs) (Hillman, Withers and Collins, 2009), and hence, firm boundary decisions.

5.2.5 Other strategic perspectives in the literature (Embeddedness & Identity)

Of further interest, in the pursuit of exploring firm boundary decisions, is Granovetter's (1985) Social Capital/Embeddedness framework shyly pointed out by Holcomb and Hitt (2007) and alluded to by Mayer and Salomon (2006). While never really expressly utilized in explaining firm boundaries, the framework has been employed in explaining Joint Venture dissolutions (Polidoro Jr., Ahuja and Mitchell, 2011) as well as partner selection decisions (Meuleman et al, 2010). At the heart of Embeddedness theory (ET) lays the potential development of interfirm relations stemming from social interaction (Payne et al., 2011) rather than the strict pursuit of short-term economic benefits. What is intriguing about ET is that it includes the concept of trust as a key ingredient in the formation of interfirm relations. By accounting trust, the ET perspective offers a complementary approach to one of TCE's core assumptions which is the opportunistic behaviour of the exchange partners of a focal organization. An informative investigation of the aforementioned premise is offered by Zaheer and Venkatraman (1995).

A final plausible theoretical framework, or rather perspective, that could potentially inform the firm boundary decision issue, is offered by Santos and Eisenhardt (2005) in the form of Organizational Identity Coherence (OIC). Based on studies of managerial cognition (Walsh, 1995; Weick, 1995), and organizational identity (Albert and Whetten, 1985; Elsbach and Kramer, 1996), OIC revolves around the argument that a firm's boundaries are aligned in such a way that they are coherent with the organization's identity.

In conclusion, the summative review of relevant literature reveals that no less than four strategic considerations or differing strategic logics are in a position to inform the exploration of a firm's firm boundary decisions. These were identified as the efficiency perspective, illustrated by the framework of Transaction Cost Economics, the dependency perspective, highlighted by Resource Dependency Theory, the competence perspective underscored by the Resource-Based View of the firm and Dynamic Capabilities Theory as well as the identity perspective put forth by Santos and Eisenhardt (2005).

At least three additional theoretical frameworks or perspectives have been used in previous studies. These include Real Options Theory (Leiblein and Miller, 2003), Embeddedness Theory and an extension of Embeddedness Theory, the Network Perspective (Yang, Lin and Lin, 2010). The scope of this study, however, is limited to the previously mentioned theoretical frameworks (bar Dynamic Capabilities Theory), mainly due to practical constraints.

5.3 Efficiency considerations through Transaction Cost Economics

Transaction Cost Economics (TCE) offers an insightful explanation of vertical integration and firm boundaries by using the transaction as a unit of analysis and by considering the effects of bounded rationality, human foresight and opportunism on organizational efficiency, given a particular institutional environment.

The discriminating alignment hypothesis of TCE is that transactions which differ in their attributes, are aligned with governance structures, which differ in their attributes (cost and competence), so as to affect an economizing result.

The main tenets of TCE were first formulated by Coase (1937). In his paper, Coase argued that firms (hierarchies) and markets are alternative ways of governing transactions. Furthermore, he postulated that choosing the most efficient governance form depended on the level of transaction costs associated with each governance mechanism. While extraordinarily insightful, the initial formulation of the theory proved difficult to corroborate or falsify due to the inherent difficulty of measuring transaction costs. A solution to the problem of operationalizing the theory as well as the theory's modern formulation was provided by Williamson (1975). In his seminal book, Williamson associated the relative efficiency of alternative governance forms with three observable attributes of transactions, asset specificity, uncertainty and frequency (Geyskens et al., 2006).

5.3.1 Main goal and assumptions of TCE

Transaction Cost Economics, as all economic schools of thought, is principally occupied by the economic problem. Summarily, the economic problem may be described as the problem of determining the optimal mode of employing the labour of a particular population, with various needs and powers (factors) of production, to maximize the utility of production (Jevons, 1879). In other words, TCE is originally aimed at providing an alternative explanation of industrial organization and production.

The contemporary formulation of TCE holds five main assumptions. These revolve around the nature of human actors as well as the fundamental characteristics of physical and social elements included in the organization of industrial production.

Beginning with the physical aspects of production, TCE holds the assumption of *Technological Inseparability*. According to this premise it is held that, technologically non-separable activities will be organized under the unified ownership of a team (Alchian and Demsetz, 1972). In simpler terms, this assumption stipulates that due to restrictions of a technological nature, certain activities will always need to be grouped together so as to effect a desirable technological outcome. Corollary to this assumption is that the organization of technologically separable activities needs to be socially derived (Williamson, 1999). In other words, the organization of activities that are not technologically bound together is subject to choice. As such, these activities may be organized in a variety of structures (principally, markets and hierarchies).

Subsequently, it would be profitable to offer the definition of two key terms of TCE, transaction and governance. According to TCE, a transaction is deemed to occur when a good or a service is transferred between technologically separable stages (or interfaces). In other words a transaction is regarded as the transference of the output of a technologically non-separable group of activities to another similarly non-separable group of activities. With regard to the term governance, it is deemed to be a means of infusing order in a relation where potential conflict threatens to undo or upset opportunities to realize mutual gains (Commons, 1932). In simpler terms, governance is a form of managing a relationship where conflict may arise. As such, transaction governance denotes a way with which the aforementioned output transferences between non-separable interfaces are governed, or in other words, managed.

Continuing with the social aspects of production, TCE further holds the assumption of *Institutionalism*. This premise stipulates that some characteristic attributes of production are affected by the institutional (socially derived) environment in which production is conducted (Williamson, 1999). The institutional environment, in turn, is deemed to be comprised by the prevailing political and judiciary societal conditions. Chief among these conditions are the prevailing laws of property and contract. In fewer words, the assumption of institutionalism holds that the governance of transactions will be affected by the political organization and laws of the society in which they are conducted.

A key corollary aspect of this premise is that, in TCE, firms are not described in technological terms (i.e. production functions) as is prevalent in other orthodox schools of economic thought. To the contrary, firms are viewed as organizational structures that enable a particular form of transaction governance to be implemented (Williamson, 1999).

The final three assumptions of TCE deal with the nature of human actors. These are the assumptions of *Human Foresight*, *Bounded Rationality* and *Opportunism* (Williamson, 1999). According to the premise of human foresight, it is stipulated that actors will attempt to foresee consequences, and will thus engage in actions that lead to more favourable outcomes. Complementary to human foresight is the assumption of bounded rationality. According to this premise, while actors attempt to foresee consequences they are cognitively limited in foreseeing them accurately, or in other words, they are boundedly rational. This essentially means that favourable outcomes are conceived inaccurately by human actors. A corollary of this premise is that all complex contracts (agreements between actors) are unavoidably incomplete, meaning that they are unable to cover all contingencies.

Lastly, the assumption of opportunism stipulates that at least some actors will not reliably disclose true conditions upon request or self-fulfill all promises (Williamson, 1999). This premise essentially holds that in some instances actors will act opportunistically in order to amplify their gains in the expense of exchange partners regardless of their initial promise. Thus, TCE puts forth that mere promise will not be self-enforcing and that contracts can only be self-enforcing in the presence of credible commitments. Credible commitments can be regarded as the offering of 'hostage' assets, or simply collateral.

5.3.2 Main propositions of TCE

Transaction Cost Economics, accounts for four governance structures (modes) that span the divide between a market form of organization and a hierarchical form of organization (manifested in a firm). These governance structures are dubbed as unassisted (or ideal) market, unrelieved hazard, credible commitment (or hybrid) and integration (firm), as per Williamson (1999; 2000). A schematic illustration of these governance structures is offered in *Figure 5-1*.

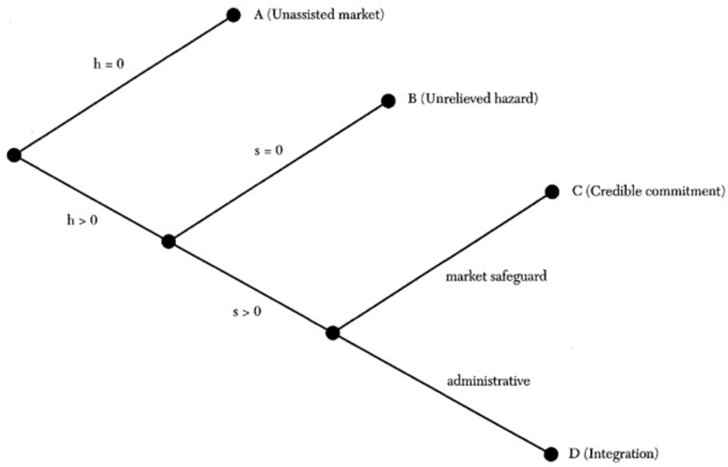


Figure 5-1. Governance structures per Williamson (2000)
(described as a simple contracting schema)

In order to align the terms used to describe these governance structures, with the terms that mostly prevail in the available literature, Williamson's terminology is complemented by Barney's (1999) designations of the terms as the following governance modes (Table 5-1). Consequently, the unassisted market governance structure is interchangeably referred upon also as Market Governance while the integration or firm governance structure is designated also as Hierarchical Governance. The intermediate governance structures of credible commitment and unrelieved hazard are referred as Hybrid Governance modes. More specifically, credible commitment is further qualified as Contractual Hybrid Governance while unrelieved hazard is referred as Relational Hybrid Governance.

Table 5-1. Designation of governance structures

Williamson's terminology	Corresponding term (per Barney)
A. Unassisted (or ideal) market	A. Market Governance
B. Unrelieved hazard	B. Relational Hybrid Governance
C. Credible commitment (hybrid)	C. Contractual Hybrid Governance
D. Integration (firm)	D. Hierarchical Governance

According to TCE, each governance structure (or mode) is discriminantly described by a series of characteristic attributes. These include: incentive intensity, administrative controls and the legal rules regime (Williamson, 1991). With regard to incentive intensity, market governance is conceived as the most intensive form with varying and declining degrees of intensity offered by the subsequent governance forms where hierarchical governance represents the most diminutive incentive intensity structure. In contrast, market governance is conceived as the form with the least amount of administrative controls, while hierarchical governance represents the structure with the most amount of control, exercised by fiat power. Intermediate forms of transaction governance, are endowed with varying levels administrative control that are influenced by the legal rules regime stipulated principally by the institutional environment as well as the agreement characteristics between the two exchanging parties.

In the heuristic schema portrayed in Figure 5-1 *h* denotes contractual hazards and *s* denotes corresponding safeguards. Market governance, represents a spot market form of transaction, also dubbed as autonomous contracting (Williamson, 2000) where the exchange is “sharp in by clear agreement; sharp out by clear performance” (Macneil, 1974 p.738). TCE considers this form as ideal, as long as contractual hazards are absent.

Contractual hazards, are considered to arise when courts are unable to verify the exchange partners’ knowledge (Williamson, 1975 p.30) or justly protect weak property rights (e.g. intellectual property), when non-easily redeployable assets are held-up in the exchange or when quality, health, safety and other risks are undisclosed by the parties involved in the exchange (Williamson, 2000).

Relational hybrid governance (or unrelieved hazard), represents a form of transaction governance where contractual hazards arise but where no safeguards are built into the exchange agreement in order to alleviate those hazards. A key issue here is the assumption of opportunism. In the eyes of TCE, if safeguards are not implemented in the form of contract contingencies, then the exposed party will be treated opportunistically by the non-exposed party and the advantageous partner will exploit the inefficiency.

Contractual hybrid governance (or credible commitment), represents a form of transaction governance where contractual hazards arise but where additional safeguards are engaged by the exchange parties in order to relieve those hazards. Such safeguards, according to TCE, include complex contracts manifested through increased contract length, the inclusion of penalties to deter breaches, provisions for information disclosure and processing as well as specialized dispute settlement mechanisms (Williamson, 2000).

Hierarchical governance (or integration) finally, represents the form of transaction governance where any possible contractual hazards are nullified through the integration of the transaction within the hierarchical structure of an autonomous entity (such as a firm). In this case, exchange hazards are negated as the exchange partners belong to the same organizational entity (thus zeroing conflicting benefit incentives) and any disputes are resolved with the exercise of fiat power (Williamson, 2000).

While, the different governance structures offer varying levels safeguarding against contractual hazards, they also represent varying levels of associated bureaucratic and other transaction costs. In general, TCE stipulates that the higher the level of safeguards in place, the higher the associated transaction costs. In a similar fashion, the more complex the structure is, the higher the associated bureaucratic costs. Thus, overall, increased safeguarding is associated with increased costs. Under this regime, TCE holds that transactions with different characteristics will yield optimum efficiency when coupled with the appropriate governance mode (discriminant alignment hypothesis). To discriminate various transactions, TCE proposes that transactions are characterized by three principle attributes: *Transaction Asset Specificity*, *Transaction Uncertainty*, and *Transaction Frequency*.

5.3.3 Basic discriminating transaction attributes

Beginning with the first of the three principle transaction attributes recognized by TCE, reference is made to transaction asset specificity. Asset specificity refers to the degree to which an asset (investment) employed within the bounds of a transaction can be redeployed to alternative uses by alternative users without sacrifice of productive value (Williamson, 1989, p.142). In the simplest of terms, asset specificity denotes the asset related exposure of an exchange partner in a transaction. Within TCE's premise of opportunism, asset specificity signifies the amount of asset resources that could potentially be held-up as 'hostage' by the exposed party's partner so that he may accrue more benefits from the transaction.

The logic behind asset specificity is that the more difficult it is to redeploy an asset to alternative uses and by alternative users, the more specific the asset is to the focal transaction. When this specificity is viewed as the cost (or sacrifice of productive value) that needs to be incurred so that the engaged assets are deployed for a different use, they may be considered as 'switching' costs. Alternatively, when equating a specific asset to the certain amount of capital that it represents, asset specificity may be viewed as the capital 'sunk' in the transaction, or similarly the costs sunk in the transaction. Summarily, in the framework of TCE, asset specificity represents the level of non-easily redeployable investments of various types, that each (or a focal) party brings to a given exchange.

Williamson (1983) initially recognized four types of asset specificity, or otherwise four types of assets that could be specific to a transaction or exchange. Those were: Human Asset Specificity, Physical Asset Specificity, Site Specificity and Dedicated Asset Specificity (ibid p.526). Later, however, Williamson (1985; 1988) complements the previously mentioned four types with an additional two: Temporal Asset Specificity and Brand Capital; for a total of six types. Zaheer and Venkatraman (1995) proposed another variant of a potentially specific asset, in the form of Procedural Asset Specificity. This last type of asset specificity was originally developed to substitute for physical asset specificity in service related contexts where the physical assets were deemed to hold little significance (e.g. De Vita et al., 2010). Nevertheless, the current study holds that physical and procedural asset specificities represent different constructs and that the presence of one type does not exclude the presence of the other. In other words, it is held that in a given setting, both physical as well as procedural asset specificity may be of significance (e.g. in settings where the service rendered requires the presence capital equipment). As such both are retained in the theoretical model to constitute an encompassing view of transaction specific investments.

Human asset specificity is perceived as idiosyncratic investments in human capital present in a particular transaction (Geyskens et al., 2006). In line with this perception, such investments are held to relate to knowledge-specific assets arising from 'learning-by-doing' (Williamson, 1996 p. 105) as well as specific training administered for the performance of tasks required by a particular transaction. As such, human asset specificity is held to represent the expertise required for said tasks as embodied in relevant costs of training and development needed to support interactions with the other party (De Vita et al., 2010).

Site asset specificity is perceived as idiosyncratic investments in facilities (Geyskens et al., 2006) usually enacted so as to reduce inventory and/or other processing costs by developing facilities in close proximity with the transaction partner (De Vita et al., 2010). To the extent that the involved facilities cannot be readily employed in the service of an alternative exchange partner, such investments are considered to be highly immobile (Williamson, 1983; Joskow, 1987) and subsequently transaction specific.

Physical asset specificity refers to idiosyncratic investments in equipment, technology or other material tangibles required for the enactment or support of a particular transaction (Geyskens et al., 2006). Examples of such assets could include an OEM manufacturer's investments in tools, dies and moulds developed specifically for a particular industrial client or even customized computer hardware and software applications adopted in order to facilitate coordination between the partners' production systems.

Dedicated capacity specificity refers to investments comprising general purpose resources as opposed to custom tailored ones that, nevertheless, result singularly from a particular transactional agreement. In other words, it refers to additional (generic) productive capacity that has been installed or enacted with the purpose of serving a particular relationship. If the exchange relationship is ended prematurely, excess capacity will be created resulting in subsequent loss of productive value (Williamson, 1983; Joskow, 1987; De Vita et al., 2010).

Procedural asset specificity refers to organizational routines and workflows tailored to a particular relationship which are difficult to modify or redeploy to other purposes without loss of value (De Vita et al., 2010). While procedural specificity may be considered to relate significantly to human assets, it is maintained separate from the conception of human asset specificity as it reflects the potentially complex procedural norms through which the know-how specified in human asset specificity is actually put to use in order to serve a relationship.

Temporal asset specificity refers to transactions where timing and coordination are of high importance in the realization of exchange value (De Vita et al., 2010). According to Malone et al. (1987) "an asset is time specific if its value is highly dependent on its reaching the user within a specified, relatively limited period of time" (p. 486). Given these observations, it is held that temporal specificity reflects costs potentially incurred or productive or other value potentially lost due to delinquencies rendered upon an exchange's schedule or delivery time-frame. In other words, it may include assets whose value depends on the adherence of the agreed schedules and time-frames stipulated in the exchange agreement.

Brand name capital refers to transaction specific assets in or through which a partner's reputation and goodwill may be put at risk (Williamson, 1991). In the simplest of terms this type of asset specificity may be understood to reflect the extent to which a firm's reputation and goodwill may somehow be compromised and lose value if the focal transaction relationship fails either to be brought to maturity or to render the expected deliverables.

Continuing with the second principle transaction attribute recognized by TCE, we encounter transaction uncertainty, or simply uncertainty. Uncertainty refers to "the degree to which ex-ante contractual costs and ex-post monitoring and enforcing costs are augmented by environmental and behavioural unpredictability, respectively" (De vita et al., 2010 p.658). This admittedly complex definition merits for some delineating comments. First of all, it is noted that ex-ante contractual costs relate to transaction costs incurred prior to the signing or ratification of the deal, while ex-post contractual costs relate to costs incurred during the implementation phase. Secondly, it is underlined that uncertainty is deemed to denote unpredictability. The aforementioned unpredictability in turn, is regarded to derive from two principal sources: the contextual environment and the behaviour of the exchange partner.

In line with the previous definition offered by De vita et al. (2010), most previous studies of uncertainty within the TCE framework have adopted its explication as unpredictability. As such, they identify three principle sources of unpredictability that affect ex-ante and ex-post contractual costs. Two of these are related to the contextual environment and include technological and market/volume uncertainty (Walker and Weber, 1984), while the third comprises the concept of behavioural uncertainty (Geyskens et al., 2006).

Within this regime, technological uncertainty refers to technological volatility, or otherwise the inability of accurately forecasting future technological developments that may impact the value or specifications of an exchange (Walker and Weber, 1984; Geyskens et al., 2006). Market/volume uncertainty, on the other hand, refers to the inability to accurately forecast the volume requirements of an exchange (Walker and Weber, 1984). This element of uncertainty has also been translated as a combination of demand and price volatility (David and Han, 2004). Both types of uncertainty, technological and market/volume, are deemed to relate to ex-ante contractual costs as they represent elements of risk that need to be considered and implemented in the formulation of a contract prior to the signing of the agreement.

Finally, this stream of TCE thought considers uncertainty stemming from the behaviour of the exchange partner embodied in the concept of behavioural uncertainty. Geyskens et al. (2006) hold that behavioural uncertainty equates to a performance evaluation problem, or as they put it, the "…difficulty in ascertaining ex post whether contractual compliance has taken place" (p.521). This designation, however, marks a differentiation from the previously received notion of uncertainty as unpredictability and allows for the discussion of an important issue. Before delving into the intricacies of behavioural uncertainty and the contentions put forth in this study, *Figure 5-2* illustrates the framework's basic premises as reported up to this point.

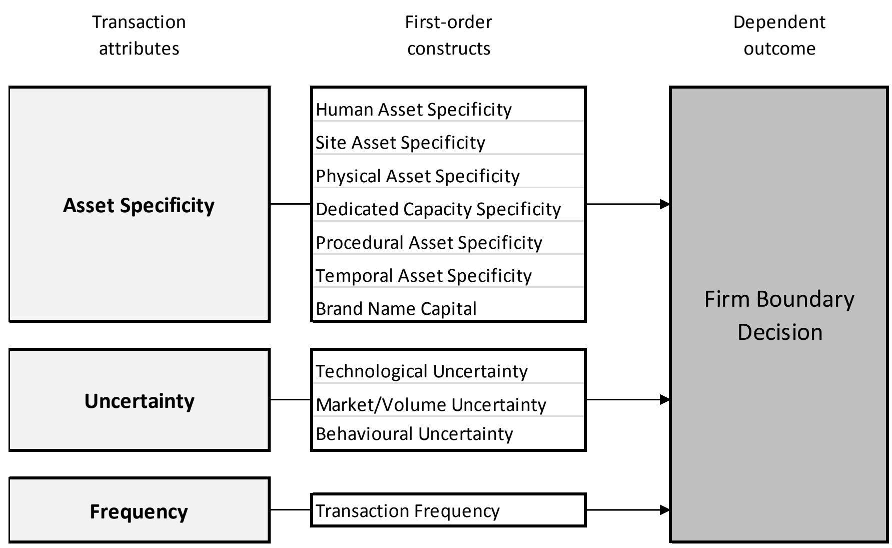


Figure 5-2. Basic Transaction Cost Economics framework of firm boundary decisions

With regard to behavioural uncertainty, it is principally contended that had this concept been truly related to the notion of unpredictability, that is the behavioural unpredictability of an exchange partner, it would denote the inability to generally predict the ex-post behaviour of the exchange partner. As such, it would not be solely equated to the performance evaluation problem, as put forth by Geyskens et al. (2006), which comprises only one of the ways with which an exchange partner may divert from contractual compliance.

To the contrary, it is put forth that behavioural uncertainty, if perceived as ex-post behavioural unpredictability, should include all aspects of the exchange partner's potential for ex-post exploitation. Therefore, apart from non-adequate contractual compliance in terms of deliverables it should also include the potential for contractual delinquency as well as attempts at the expropriation of value exposed in the relationship. As such, it is put forth that the inability to predict the ex-post behaviour of the exchange partner should include the probability that the exchange partner will try to expropriate potentially exposed value in the exchange (i.e. value present in or generated by specific assets), will withdraw from the contract all together or simply provide inadequate service to the terms of the contract.

This observed inconsistency is evidence of the intertwined yet sometimes uneasy relationship between what has been dubbed as Williamson's strand of TCE thought and the measurement branch of TCE originating from Alchian and Demsetz's (1972) work on information costs (Carter and Hodgson, 2006). An implied yet rarely stated occurrence is that, researchers interested in testing the validity of TCE usually adopt the former, more restricted, Williamsonean strand and austerely adhere to it (e.g. David and Han, 2004; Carter and Hodgson, 2006) while researchers interested in the better explanation of the phenomenon focus on extended versions of TCE thought (e.g. Santos and Eisenahardt, 2005). An insightful exposition of this tendency is offered by Jacobides and Hitt (2005).

The present research falls within the category of studies interested in the better explanation of firm boundary decisions, and therefore seeks to reconcile the two strands so as to derive a parsimonious yet encompassing theoretical framework. As such, this study holds the perceived notion of uncertainty as the unpredictability of future states and maintains the definitions of technological and market/volume uncertainty reported previously. With regard to behavioural uncertainty, however, the study holds it to represent the inability to predict the ex-post behaviour of the exchange partner as it relates with all aspects of contractual compliance, a notion not restricted solely to the consideration of performance evaluation issues.

The performance evaluation issue, while pertaining strongly to certain aspects of an exchange partner's ex-post behaviour, is considered to do so only in an indirect manner as an obstacle against the safeguarding from one particular manifestation of post-contractual non-compliance. As such, it is held as a measurement difficulty issue that may be overcome with the application of thought-out, yet cost-incurring, monitoring measures. Consequently, it is considered as a factor separate from behavioural uncertainty.

To assist the delineation of factors affecting firm boundary decisions within the TCE overall rationale, the performance evaluation/measurement concern, is treated individually as an additional transaction attribute that is principally informed by the Information Asymmetry perspective (Akerlof, 1970). As illustrated by Jacobides and Hitt (2005), measurement difficulties concern both ex-ante as well as ex-post considerations of transaction costs. Ex-ante, the issue pertains to the ability of assessing the value of the goods or services exchanged (labelled in the framework as Value Assessment Ability) while in ex-post situations it reflects the performance evaluation problem mentioned previously (labelled in the framework as Contribution Assessment Ability) (ibid). The performance evaluation problem has also been referred to as performance ambiguity (Stump and Heide, 1996), task uncertainty (Santoro and McGill, 2005) as well as the observability issue (Mayer and Salomon 2006). The TCE framework with the inclusion of the information asymmetry perspective is illustrated in *Figure 5-3*.

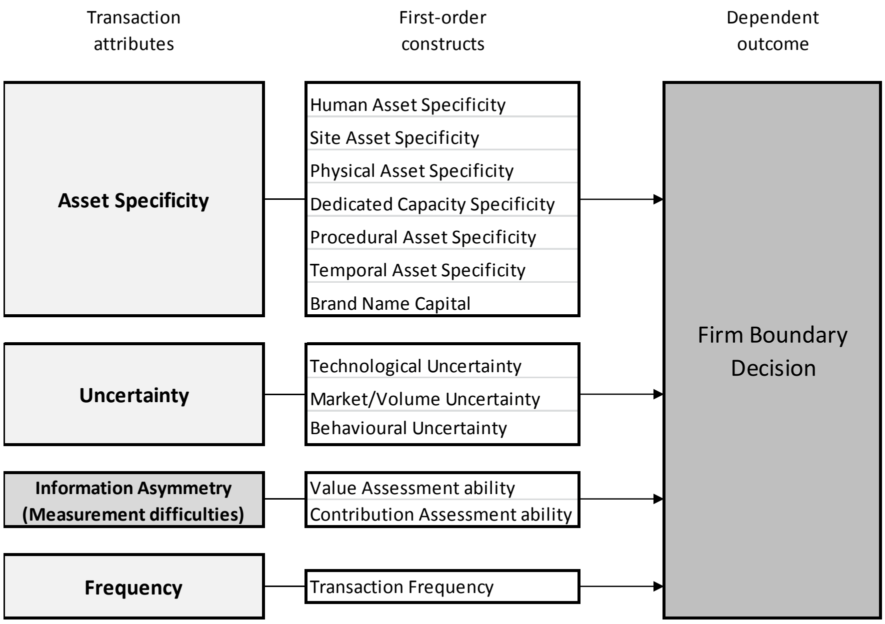


Figure 5-3. Transaction Cost Economics framework informed by information asymmetry

Upon disassociating the concept of behavioural uncertainty from received notions of measurement and performance evaluation issues, it may be argued that the model allows a certain amount of ambiguity to surround the concepts reflected in behavioural uncertainty. In a nutshell, it is put forth that behavioural uncertainty may simply be held to reflect a focal firm's expectations of opportunistic behaviour on behalf of a potential exchange partner. In other words, it is put forth that opportunism, instead of being a partially held assumption removed from the model's workings, may be meaningfully captured and accounted for in the form of behavioural uncertainty. As the study's TCE-based framework is further analysed and delineated in the next sub-sections, the unique role of behavioural uncertainty within the model will be fully explored and reported.

The third and final transaction attribute recognized by TCE, is transaction frequency. Transaction frequency refers to the extent to which a transaction recurs (Geyskens et al, 2006). According to Williamson (1985), the overall transaction costs incurred by a recurring exchange increase as frequency increases and may reach a point at which they offset the overhead costs incurred by the vertical integration of the exchange. As such TCE posits that the higher the frequency, the more probable it is that the focal transaction will be assimilated in a hierarchical governance structure. While constituting one of the three principle transaction attributes, frequency has received very limited attention in previous studies. This research programme deficiency was previously observed by Rindfleisch and Heide (1997) and later reaffirmed by Geyskens et al. (2006). Regardless of this purported disregard for transaction frequency, the present study includes it as an integral proposition of TCE that merits, at any rate, to be considered or at the very least controlled for.

In the following sections, the original TCE framework is further developed to incorporate recent contributions to the academic discourse of TCE as well as this study's novel assertions. Following these refinements, the study's final TCE-based model of firm boundary decisions is presented.

5.3.4 Exposed value beyond asset specificity

Figure 5-3, in the previous section illustrates the basic transaction cost economics framework with measurement difficulty related issues treated separately from traditional conceptions of uncertainty. As such, at this point of conceptual development, the model incorporates four principle transaction attributes held to influence a firm's boundary decision. In their broadest sense, these include transaction asset specificity, uncertainty, information asymmetry (or measurement difficulties) and frequency, with the first three constituting discrete attribute groups containing multiple fine-grained first-order constructs.

To better explicate the specific propositions put forth by the operationalization of efficiency considerations through transaction cost economics, the related framework will from here on out be conceptually analysed on the basis of implied higher-order constructs. Upon exploring the alignment mechanisms of transaction cost economics, two basic higher-order overarching constructs are held to be at the heart of the theory's rationale. Given the consideration of a particular transaction, whose product is of interest to a focal firm, TCE puts forth that the two issues that the firm has to consider before deciding the transaction's governance structure are: (a) the potential loss of productive value as well as (b) various management costs associated with the transaction within each governance structure.

Concerning the issue of productive value loss, the framework reasons that in a given transaction, a focal firm may have to contribute or invest in assets (productive resources) so that the transaction is put into effect. Subsequently, it is put forth that these assets may represent the potential for productive value loss in the case of contract failure. Specifically, it is proposed that if the assets cannot be redeployed to alternative uses or be used by alternative users without loss of productive value, then they represent assets 'sunk' in the transaction. As such, they are expected to incur switching costs if the need for redeployment arises. Thus, in the case of contract failure, value loss occurs as it may be costly to redeploy the relevant assets to some other productive area of the firm. This costly redeployment of assets is denoted in the study's developing framework as a second-order construct dubbed 'Costs sunk in the transaction' *(Figure 5-4)*. Nevertheless, it has been proposed that switching costs, or otherwise assets held up in the transaction, may represent a construct set that comprises only a subtotal of the framework's overarching concern for the loss of productive value.

In line with the foregoing proposition, it is maintained that asset specificity may be only one of the ways with which productive value may be exposed and/or subjected to expropriation in the case of contract failure. This assertion becomes clearer once brand name capital is considered. In all senses, an intangible asset such as brand name capital cannot be held to be part of the asset specificity construct as a non-easily redeployable asset. A firm's reputation cannot be held up in a transaction in any traditional sense of the term as it permeates all of a focal firm's activities regardless of its presence in a specific transaction. Nevertheless, it may still be considered meaningfully as productive value exposed in a transaction, independent of specificity concerns. As such, the issue of productive value exposure is considered as a third-order construct within the framework, dubbed 'Productive Value Exposed', with the second-order construct of 'Costs sunk in the transaction' as one of its constituent elements *(Figure 5-4)*.

To accommodate for the unique way with which brand name capital contributes to the sum of productive value that may potentially be lost, a further second-order construct is introduced. Dubbed, 'Other Value Exposed', the construct seeks to capture alternative ways with which value may be exposed and subjected to expropriation in a specific transaction. More specifically, the construct focuses on value exposed through the exposure of intangible assets with inherent or even situational value. As such, brand name capital is considered one of its principle constituent elements, yet it may not be the only one. In addition to a focal firm's reputation, at least two further concerns are put forth to complement the concept of value exposure in terms of intangible assets. These concerns owe their conceptual origin to the appropriability issue primarily explored by Teece (1986) and subsequently articulated further by Pisano (1990). In a few words, the appropriability issue refers to contracting hazards that expose valuable intellectual property and/or proprietary information and technology to expropriation (Mayer and Salomon, 2006).

Given the aforementioned contributions to the academic discourse, the first concern regards the exposure of intellectual property, while the second considers the exposure of privileged information that may hold situational value. In the case of intellectual property, it is maintained that proprietary assets such as novel know-how and other specific technological or procedural knowledge that a firm owns or has developed for competitive use, may be exposed to expropriation in a transaction by an opportunistic exchange partner (Oxley, 1997; Gulati and Singh, 1998). As such, they could very well represent the potential for loss of productive value if misappropriated or leaked to competitors. In the case of privileged information, it is put forth that situation or temporally specific information and knowledge may further reflect the potential for productive value loss if misappropriated or disseminated to competing economic actors (Mayer and Salomon, 2006). Such valuable privileged information may include the operational status of a firm's capital equipment, a falling out of key decision-makers, or even changes in a key customer's supply needs. In sum, they are considered to include the totality of information to which an exchange partner may have access, and which may result to loss of value if exploited.

Given the foregoing discussion, the transaction attribute of Asset Specificity representing concerns for switching costs or otherwise costs 'sunk' in the transaction is accompanied with a new transaction attribute named 'Proprietary Asset Exposure', held to reflect concerns for the exposure of intangible assets with inherent or situational value. Both attribute groups are deemed to comprise first-order constructs that in turn make-up the second-order constructs of 'Costs sunk in the transaction' and 'Other Value Exposed' respectively, while these last second-order constructs are deemed to finally make-up the third order construct of 'Productive Value Exposed'. The aforementioned refinements, along with the yet unexplored conceptual structure of the theory's second overarching concern for a transaction's governance costs are illustrated in

Figure 5-4. While transaction governance costs are also considered as a third-order construct, its constituent elements are tentatively grouped together pending further analysis.

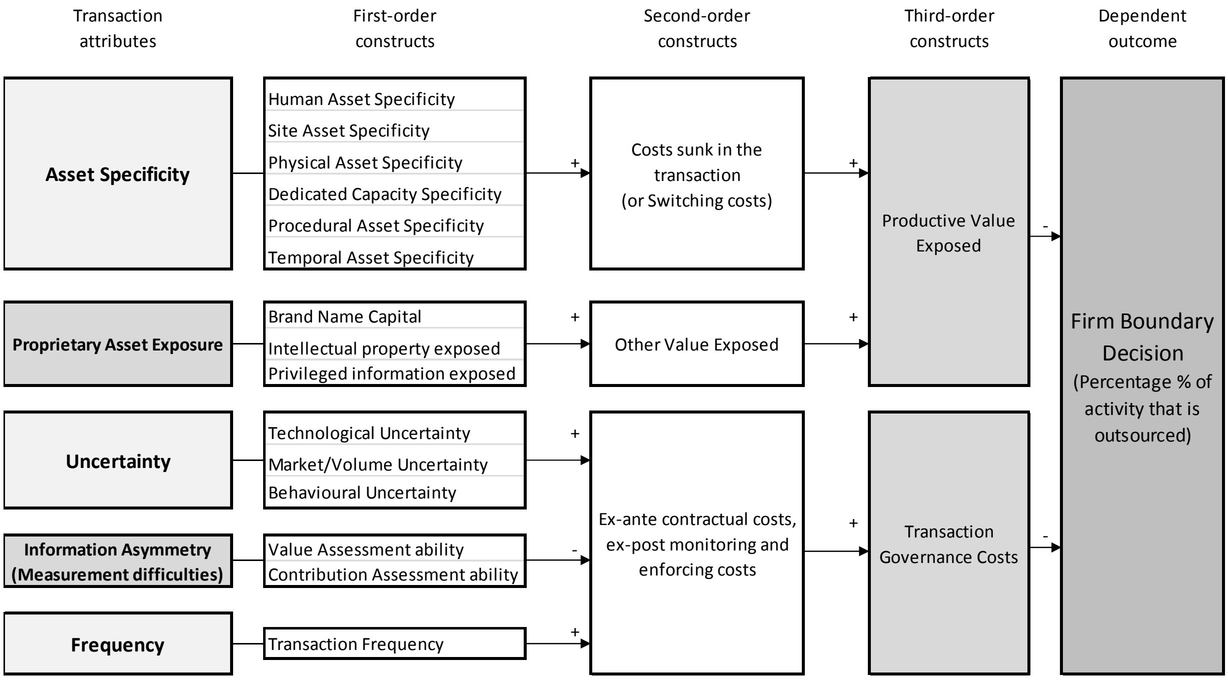


Figure 5-4. First, second and third-order constructs underlining TCE's alignment hypotheses

5.3.5 The discrete role of behavioural uncertainty

In this section, one of this study's main contentions with received notions of transaction cost economics is reported. The main thesis of this contention is that behavioural uncertainty denotes a lot more than the ex-post performance evaluation issue and that it stands to be a medium through which the oftentimes haphazard assumption of opportunism may be meaningfully operationalized as a construct directly informing the framework's hypotheses.

As reported in the previous chapter, the notion of behavioural uncertainty is perceived in this study as ex-post behavioural unpredictability that includes an exchange partner's potential for lacklustre ex-post performance, the likelihood of value expropriation through forced contract renegotiation, as well as the possibility of contract failure through the exchange partner's withdrawal. Furthermore, it is proposed that in any given context, a focal economic actor seeking to choose the governance structure of a particular transaction will always consider (explicitly or even implicitly) received perceptions of the opportunistic tendencies of potential exchange partners. These perceptions, in turn may not necessarily reflect some objective reality, yet they will adequately represent the economic actor's expectation or perceived likelihood of opportunism present in an exchange configuration.

As such, behavioural uncertainty is regarded as a major constituent element of a novel second-order construct dubbed here 'Likelihood of Opportunism'. This construct is introduced to embody the assumption of opportunism within the framework's operational structure. The framework's structure, along with the proposed construct interactions is portrayed in *Figure 5-5*.

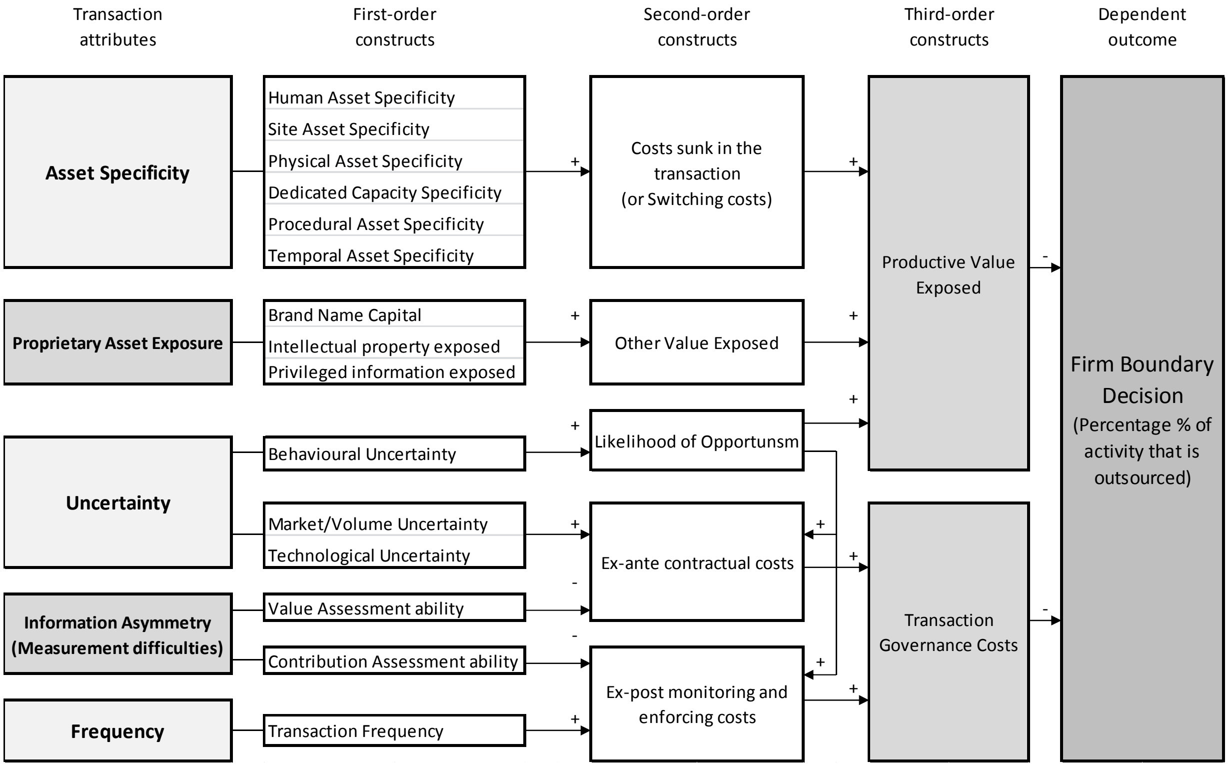


Figure 5-5. TCE framework with behavioural uncertainty as an indicator of opportunism

In explicating the proposed framework structure, it is noted that the third-order construct of transaction governance costs is considered to consist of two second-order constructs reflecting the theory's ex-ante and ex-post governance costs respectively. These are labelled as 'Ex-ante contractual costs' and 'Ex-post monitoring and enforcing costs' and both are expected to contribute positively to the overall level of a transaction's governance costs. In line with the propositions reported in the previous sections, market/volume and technological uncertainty are considered as two elements positively influencing the construct of ex-ante contractual costs, while the value assessment ability aspect of the measurement difficulties issue is thought to negatively impact the same second-order construct (i.e. the higher a transacting focal firm's value assessment ability the lower the ex-ante contractual costs are expected to be). Ex-post monitoring and enforcing costs are held to intensify as transaction frequency increases while the contribution assessment ability aspect of the measurement difficulties issue is respectively held to negatively impact the same construct (i.e. the higher a transacting focal firm's contribution assessment ability the lower the ex-post monitoring and enforcing costs are expected to be).

Having outlined the basic interactions of a transaction's governance costs, emphasis in now put on the discrete role and impact of the novel likelihood of opportunism construct. Primarily, the perceived likelihood of opportunism is expected to directly inform the third-order construct of Productive Value Exposed, embodying the exposure of a focal firm's productive value in a given exchange. This relationship is considered as a sine qua non for the framework as the likelihood of opportunism is essentially the element that constitutes the notion of exposure or risk for the assets invested in the transaction. If the likelihood of opportunism is nullified then the level of asset specificity has no meaningful role to play in the selection of a transaction's governance structure. To the contrary, the higher the level of the likelihood of opportunism, the higher the impact of asset specificity as the risk to which the assets are exposed is heightened.

Furthermore, informed by the emphasis traditionally ascribed to the ex-post behaviour of the exchange partner with regard to compliance to the terms of the contract, the likelihood of opportunism is expected to positively influence ex-post monitoring and enforcing costs. This relationship reflects the potential for inadequate post-contractual performance on behalf of the exchange partner and is expected to be alleviated by the focal firm's contribution assessment ability. Apart from effects on ex-post transaction governance costs, however, a further assertion is put forth with regard to the effect of the likelihood of opportunism on ex-ante contractual costs. In that context, it is proposed that an exchange partner, if sufficiently opportunistic, may attempt to misrepresent the value or benefit of the deliverables stipulated in the agreement. Therefore, the likelihood of opportunism is thought to positively influence ex-ante contractual costs in a fashion much like the influence on ex-post transaction costs. Finally, in parallel with the contribution assessment ability, the focal firm's value assessment ability is held to alleviate the cost-incurring effects of an exchange partner's pre-contractual opportunistic tendencies.

The foregoing propositions with regard to the role of behavioural uncertainty and opportunism in the TCE framework adhere to and attempt to remedy the behavioural assumption criticisms underlined by Moran and Ghosal (1996) by withdrawing the consideration of opportunism as a constant and non-varying condition. The approach further relates, though limitedly, to Verbeke and Greidanus's (2009) proposed solution to the issue.

5.3.6 Reciprocal exposure and the moderation of opportunism

In continuing the exploration and development of the TCE-based framework of firm boundary decisions, this section emphasizes the seminal issue of reciprocal exposure initially explored by Klein and Leffler (1981) and clearly articulated by Williamson (1983). Perceived from the beginning as an additional safeguard device against opportunism, concerns of reciprocal exposure are scarcely taken into consideration in transaction cost studies (bar contributions offered by Zaheer and Venkatraman, 1995; Joshi and Stump, 1999; Buvik and Reve, 2001; De vita et al. 2010). This deficiency is remedied in this study with its acknowledgement, consideration and integration in the developed TCE-based framework.

The issue of reciprocal exposure essentially emphasizes the fact that assets 'sunk' in a transaction, or otherwise transaction specific assets, may stem also by the exchange partner and not only by a focal firm seeking to determine a transaction's governance structure. As such, it is asserted that the unilateral consideration of asset specificity may obscure the complete portrayal of a given transaction. Essentially, if one were to consider the asset specificity of the focal economic actor (also referred as the principal for clearer reference) without taking into account the reciprocal asset specificity of the exchange partner (labelled agent, respectively), then a skewed view of the transaction circumstances may be extracted. This derives from the fact that the same mechanisms of potential value expropriation that stand for the principal, also hold for the agent. In other words, if the agent has invested in assets specific to the transaction, those assets may be held up by an opportunistic principal, in the same way that the principal's specific assets may be held up by an opportunistic agent.

Consequently, if the levels of specific assets invested in the transaction appear in equal amounts by both exchange partners, then both sides stand to jeopardize or lose assets of equivalent value. Thus, in ceteris paribus conditions, opportunistic tendencies would result in a zero-sum game and no side would stand to benefit from the expropriation of exposed value. In such a premise then, asset specificity would have little or nothing to contribute in the explication of a boundary decision since no clear economic advantage may either way be discerned. This is a singularly prominent implication that showcases the importance of considering reciprocal exposure. Evidently, if the agent’s asset specificity were not accounted for, the framework could reach entirely different conclusions.

The aforementioned rationale explicating the workings of reciprocal exposure, however, should not be confined strictly to asset specificity. Given the discussion on exposed value offered earlier in the chapter, it is understood that an economic actor’s value at risk, further to specific assets, may also include intangible assets with embedded or situational productive value (i.e. exposed intellectual property, brand capital and privileged information). As such, when discussing an agent’s reciprocal exposure in this study, both constructs of switching costs (asset specificity) as well as proprietary assets (other value exposed) are taken into consideration and accounted for on behalf of the agent.

When viewed from the perspective of a principal interested in discerning the circumstances of a transaction’s governance structure, the presence of an agent’s reciprocal specific investments or intangible valuable assets signal the presence of credible commitments in the transaction on behalf of the agent (Williamson, 1983). Thus the concept’s most valuable insight is revealed in that it eases the principal’s concerns for an agent’s potential for opportunistic behaviour. In the presence of credible commitments the agent does not stand isolated from value exposure and any opportunistic tendencies would expectedly yield retaliatory action. Therefore, the main effect of reciprocal exposure is thought to be its ability to moderate expectations of opportunism.

As such, within the framework developed in this study, reciprocal exposure is considered as an additional transaction attribute whose first-order constructs inform the second-order construct of the principal’s perceived likelihood of opportunism. Thus, it is put besides and against the element of behavioural uncertainty as a potentially balancing factor. Furthermore, as mentioned previously, it is thought to include both the agent’s asset specificity as well as the agent’s proprietary assets exposed in the transaction. The TCE-based framework with the inclusion of reciprocal exposure informing the perceived likelihood of opportunism is portrayed in *Figure 5-6*.

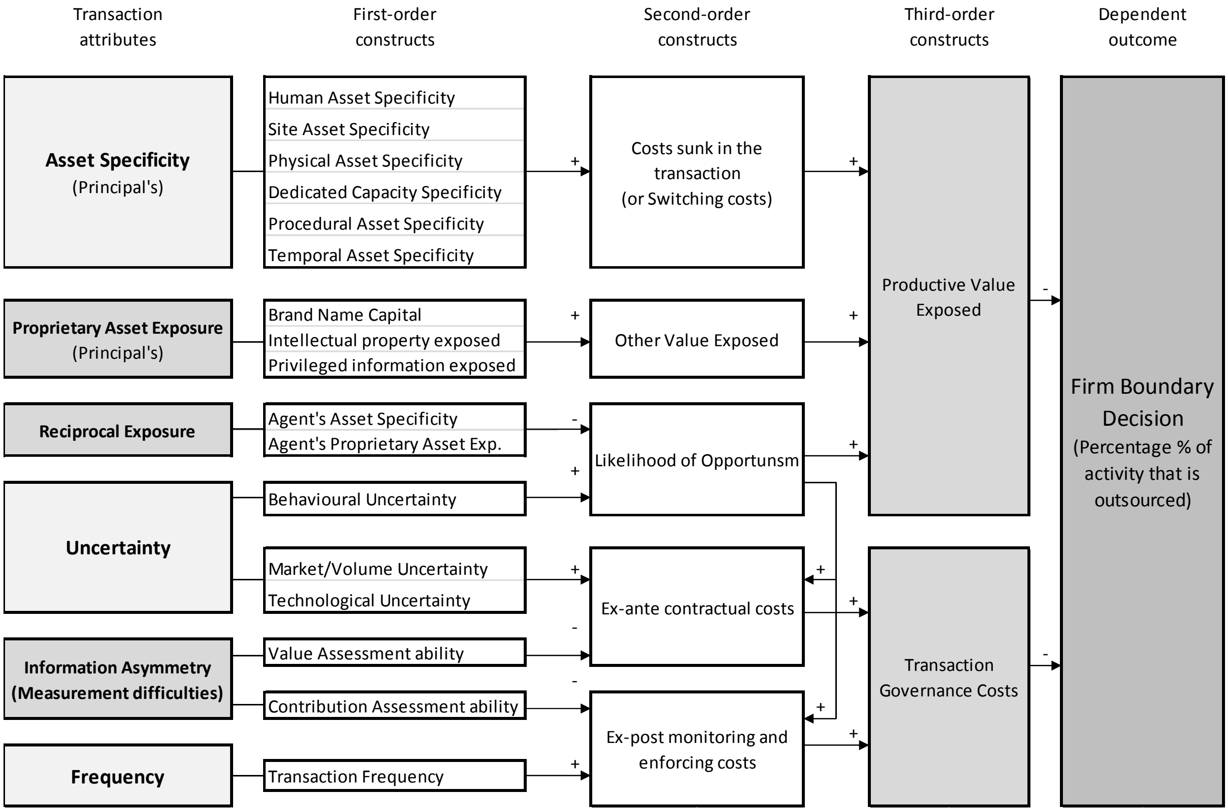


Figure 5-6. The TCE framework with the consideration of reciprocal exposure

5.3.7 Hypotheses derived from efficiency considerations

Having explored the various considerations put forth by transaction cost economics and the academic discourse surrounding it, the study now derives a series of efficiency-based hypotheses slated to be tested in the study's empirical context.

Given the study's view of behavioural uncertainty as a central concept ascribing meaning to the rest of the TCE-based approach to efficiency considerations, the propositions put forth begin with this core tenet. In following the conceptual track of influences depicted in the study's final TCE-based conceptual framework (Figure 5-6), higher behavioural uncertainty is deemed to increase the focal firm's perceived likelihood of opportunism. This increase in the perceived likelihood of opportunism, in turn, is deemed to increase the level of Productive Value Exposed in the transaction, thus lowering the focal firm's willingness to outsource the transaction in question. Furthermore, by exacerbating both the expected levels of ex-ante contractual as well as ex-post monitoring and enforcing costs, behavioural uncertainty is deemed to further increase the level of expected Transaction Governance Costs, thus again lowering the focal firm's willingness to outsource the transaction in question. As such, the extracted proposition and associated hypothesis states that:

H_{TCE1}: The higher the level of behavioural uncertainty is, the less outsourced the focal transaction is likely to be.

Following then the traditional tenets of TCE with regard to the issue of the principal's (focal firm's) asset specificity, higher levels of said asset specificity are deemed to lead to higher levels of costs sunk in the transaction, and thus, higher levels of productive value exposed. As such:

H_{TCE2}: The higher the level of the principal's asset specificity is, the less outsourced the focal transaction is likely to be.

Subsequently, acknowledging the extension of the concept of exposed value beyond asset specificity, focus is put on the principal's proprietary asset exposure construct. Following a causal path parallel to that of the principal's asset specificity, higher levels of proprietary asset exposure are thought to lead to higher levels of other value exposed and, again, higher levels of productive value exposed. As such:

H_{TCE3}: The higher the level of the principal's proprietary asset exposure is, the less outsourced the focal transaction is likely to be.

Afterwards, focus is put on the issue of reciprocal exposure, due to its hypothesized alleviating effects on expectations of opportunism. Interweaving both the agent's asset specificity as well as proprietary asset exposure, higher levels of both constructs are deemed to signal credible commitments on behalf of the agent thus lowering expectations of opportunism. Lower expectations of opportunism, in turn, are perceived to lower both the levels of productive value exposed as well as the levels of transaction governance costs. As such:

H_{TCE4}: The higher the level of the agent's asset specificity is, the more outsourced the focal transaction is likely to be.

H_{TCE5}: The higher the level of the agent's proprietary asset exposure is, the more outsourced the focal transaction is likely to be.

Subsequently, focus is put on TCE's received notions of environmental uncertainty in the form of both market/volume uncertainty as well as technological uncertainty. Both constructs are deemed to exacerbate the expected levels of ex-ante contractual costs, thus, increasing the levels of expected transaction governance costs. As such:

H_{TCE6}: The higher the level of market/volume uncertainty is, the less outsourced the focal transaction is likely to be.

H_{TCE7}: The higher the level of technological uncertainty is, the less outsourced the focal transaction is likely to be.

Afterwards, focus is put on the insights provided by the information asymmetry or measurement school of transaction cost economics, in the form of value assessment ability as well as contribution assessment ability. Higher levels of value assessment ability are deemed to lower the expected levels of ex-ante contractual costs, while higher levels of contribution assessment ability are deemed to lower the expected levels of ex-post monitoring and enforcing costs. Both tendencies, in their respective manner, are then thought to lower the expected levels of the transaction's governance costs, thus leading to a principal's higher willingness to outsource the transaction in question. As such:

H_{TCE8}: The higher the level of the value assessment ability is, the more outsourced the focal transaction is likely to be.

H_{TCE9}: The higher the level of the contribution assessment ability is, the more outsourced the focal transaction is likely to be.

Finally, covering the issue of transaction frequency, higher levels of frequency are deemed to exacerbate the levels of ex-post monitoring and enforcing costs, thus leading to higher levels of transaction governance costs. As such:

H_{TCE10}: The higher the level of transaction frequency is, the less outsourced the focal transaction is likely to be.

5.4 Dependency considerations through Resource Dependence Theory

Resource Dependence Theory offers an explanation of vertical integration and firm boundaries by using the resource as a unit of analysis and by considering the effects of environmental uncertainty and network interconnectedness on organizational autonomy.

The discriminant alignment hypothesis of RDT is that resources, deemed critical for a firm's operation, are aligned with governance structures by which the firm bypasses or absorbs external sourcing constraints, so as to achieve autonomy and avoid dependence.

RDT's roots stem from Emerson's (1962) theory of power-dependence relations. Emerson theorized that in a dyadic relationship between actors, each actor has a power capability over the other actor that is the inverse of the latter actor's dependence on the former. Several years later, Pfeffer and Salancik (1978) extended and Emerson's framework and developed the principle tenets of RDT in their influential publication, 'The External Control of Organizations: A Resource Dependence Perspective. In their book, Pfeffer and Salancik (1978) describe the firm as an actor operating in an open system that is dependent on contingencies of the external environment (described as the firm's ecology). As such, the theory proposes that each firm is responsible for the management of multiple intercorporate relationships through which it acquires the resources necessary for its operation. These relationships, in turn, represent the dependencies to which the firm is exposed, and which may potentially put constraints in the sourcing of said necessary resources. RDT offers a perspective of firm boundaries through the lens of influence, power and control. As such, Santos and Eisenhardt (2005) classify the framework as a conception depicting boundaries of power.

5.4.1 Main goal and assumptions of RDT

Resource Dependence Theory is a framework of organizational behaviour occupied by the problem of industrial organization at the level of an organizational unit, such as a firm. RDT begins the formulation of its premises in recognizing that organizations are the fundamental units appropriate for the study of intercorporate relations. Furthermore, the theory holds that these organizations are not autonomous (closed systems) as they depend on the ability to procure critical resources from the external environment (Pfeffer, 1987).

Building on the aforementioned premises, RDT further assumes the existence of *uncertainty* (not further qualified, as in TCE) that over time gives rise to a network of unpredictable interdependencies between organizations. This network of interdependencies is theorized to emerge and is taken for granted at the beginning of an RDT analysis. Each interdependency is thought to represent a potential constraint in the flow of resources to the organization as it falls outside of its sphere of control. Finally, within the premise of uncertainty, RDT implicitly assumes that each dependency bears the hazard of *opportunism* (similar, yet unlike the one described in TCE) in the form of value expropriation. The magnitude of this value expropriation hazard is expected to be determined by each dependency's particular attributes.

5.4.2 Main propositions of RDT

To reduce uncertainty in the flow of valued resources, RDT further holds that, organizations will try to restructure their interdependencies either unilaterally or bilaterally by bypassing or acting on the source of potential constraint, respectively (Casciaro and Piskorsky, 2005).

In a unilateral constraint avoidance action, RDT holds that the constrained organization may bypass the source of the constraint either by reducing its interest in the focal resource or by developing alternative sources of supply (ibid). At the level of a specific interdependency between a focal firm and a particular other supplying firm, the development of alternative sources of supply translates as a restructuring of the focal firm's sourcing strategy. That restructuring may lead the focal firm to either develop the resource internally or to supply it from another or multiple other supplying firms. At the level of a focal firm's interdependency by suppliers in general, the development of alternative sources of supply translates simply as the internal development of the resource (either by the focal firm alone, or perhaps in the context of a strategic partnership with another firm).

In a bilateral setting of action, RDT holds that the constrained organization may act directly on the source of the constraint in a variety of ways. The weakest form of action is the tactic of cooptation (Casciaro and Piskorsky, 2005). In cooptation, the constrained organization attempts to stabilize or ensure the flow of the focal resource by creating vested interests through socialization, information sharing, or even participation in managerial boards. Under the guise of this tactic, the constrained organization offers the constraining party another resource of value, such as information, friendship, or status, in the hope that the latter will choose not to exercise its power (Emerson, 1962).

Aside from the tactic of cooptation, the constrained organization may embark on a series of, what are called, constraint absorption actions. Constraint absorption involves the partial or complete obtainment of the rights to control the resource that creates the dependency. Partial constraint absorption can be achieved through the enactment of formal long-term contracts with the supplying party, or through more purpose-specific structures such as joint ventures (Pfeffer and Leong, 1977). Complete constraint absorption finally, can be achieved through mergers and acquisitions (Pfeffer and Salancik, 1978). Within that setting, the constrained party may merge or outright acquire the constraining organization and integrate the constraint. This last resort however, as Casciaro and Piskorsky (2005) point out, may not always be a viable option for the constrained organization, as is arguably a contextually dependent possibility.

On a final note, the study recognizes that the restructuring of interdependencies advocated by RDT, e.g. through the internal development of a resource or through its partial or complete integration echo the transaction governance structures put forth by TCE. As such, it is held that both frameworks theorize on the same dependent variable determined by firm boundary decisions.

5.4.3 Power imbalance and mutual dependence

Emerson (1962) put forth that in a given dyadic relationship, an actor's power over the other actor is the inverse of the other actor's dependence on the former. An actor's dependence over a focal resource, in turn, is defined as a function of the resource's criticality and the availability of alternative providers of the resource (Casciaro and Piskorsky, 2005).

According to Jacobs (1974), resource criticality or resource essentiality refers to resources which the focal organization cannot substitute for without incurring unacceptable costs. In other words, a resource is considered critical if it is essential to the functioning and daily operations of the organization.

Concerning the availability of alternative sources of supply, Jacobs (1974) based on Samuelson (1970, p.474-499), underlines that a supplier's or buyer's power in a dyadic relationship increases as the number of alternative suppliers or buyers, respectively, decreases. Indeed, where there are a sufficiently small enough number of buyers or suppliers, so that each controls a significant portion of the market for a particular resource, then each buyer/supplier can be expected to have at least some oligopolistic or oligopsonistic power.

Based on the aforementioned concepts, Jacobs (1974) further offers a methodology of ranking an organizations dependencies, where the perceived (or otherwise calculated) essentiality of a resource is multiplied by one over the number of alternative suppliers for said resource. Consequently, the higher the eventual ratio the more potentially problematic is the dependency.

The basic constructs that inform RDT are Power Imbalance and Mutual Dependence. According to Casciaro and Piskirsky (2005), power imbalance is the difference in the power of each actor over the other. Alternatively stated by Lawler and Yoon (1996), power imbalance may be regarded as the difference (i.e. subtraction) between two actors' dependencies, or the ratio of the power of the more powerful actor to that of the less powerful actor. Mutual dependence, on the other hand, is a construct based on exactly the same premises, yet instead of the difference, examines the overall levels of dependence exhibited by the two actors. As such it is calculated as the sum of the two actor's dependencies.

As mentioned earlier, RDT is concerned with the problem of value expropriation. In recognizing that interdependencies pose a threat to a focal firm's ability to appropriate its due value, the framework favours autonomy as a zero-threat state. In a fully autonomous structure, all the value appropriation potential remains within the organization and the possibility for expropriation is nullified. Nevertheless, the fully autonomous state is an unattainable ideal. Thus the framework resorts to the control mechanisms of power and its inverse, dependence, and puts forth that no expropriation will occur when neither party is advantaged, while the potential of positive expropriation increases as the power capability over the other party increases.

As such, Pfeffer and Salancik (1978) theorized that power imbalance would be the foremost determinant of value appropriation in an exchange, and thus of constraint bypass or absorption actions. Casciaro and Piskorsky (2005) underlined the weaknesses of considering power imbalance as the sole determinant and complemented it with the concept of mutual dependence as a co-determinant factor. *Figure 5-7*, illustrates the basic RDT framework as described in the previous paragraphs.

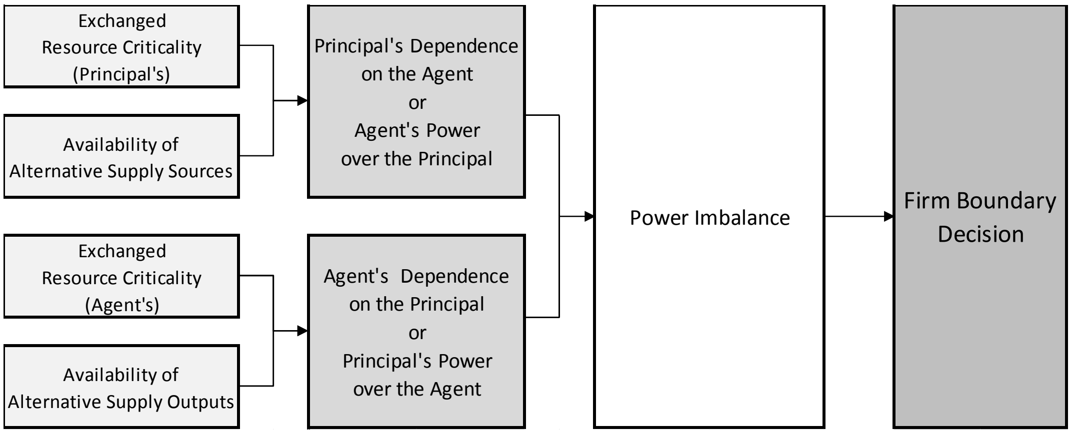


Figure 5-7. Basic Resource Dependence Theory framework of firm boundary decisions

5.4.4 Accounting the potential for power restructuring operations

As mentioned in the section reporting the main propositions of RDT, the constrained organization may opt for a series of power restructuring operations in order to ensure the flow of the focal resource. These power restructuring operations, according to Casciaro and Piskorski (2005), may be categorized in unilateral and bilateral actions. Unilateral power restructuring operations are thought to be carried out “by acting on elements outside the focal dyadic relationship” (ibid.) while bilateral restructuring operations are perceived to focus on the dyadic relationship itself and include the co-optation and constraint-absorption tactics described earlier.

In unilateral power restructuring operations, according to Casciaro and Piskorski (2005), the focal firm may (1) opt to reduce the interest in the focal resource, and thus reduce dependence, (2) form coalitions, to ensure steadier and perhaps more dependable sources, or (3) cultivate alternative providers. Given the contextual circumstances formed within the servitization of manufacturing phenomenon, it is put forth that the most prominent form of unilateral restructuring operations on behalf of a focal firm in need of the functionality of a technological artefact would be the internalization, or internal development, of transactions that would ensure continued access to the functionality in question. For example, if the resource under study were the maintenance operations associated with a needed technological artefact then the simplest and often most efficient unilateral power-restructuring operation would be the internalization of those maintenance operations within the auspices of the focal firm’s technical department.

Whether unilateral or bilateral, in this study, power restructuring operations and in particular dependent on the relative ease with which they may be carried out, are thought of as additional factors that could influence the focal firm’s sourcing decisions. In other words, it is put forth that the easier or more feasible these operations are perceived to be on behalf of the focal company, in ceteris paribus conditions the more likely the company is to pursue an outsourcing initiative. The rationale behind this proposition is that, a higher co-optation potential, for example, would ease the focal firm’s worries for value expropriation issues while the potential to internalize the related activities with relative ease would hold off any such value expropriation attempts from occurring. As such, the potential for power restructuring operations could be thought of as a factor mitigating the likelihood of negative repercussions deriving from an outsourcing initiative.

To account for the influence of a focal firm's potential for power restructuring operations, the study's RDT framework is complemented with two novel constructs aimed at reflecting this line of reasoning. The first, named 'Resource Internalization Potential' is held to represent the relative ease or difficulty with which the focal firm could internalize, or internally develop, the resource or activity in question. The second, named 'Cooptation Potential' is held to represent the focal firm's ability to potentially influence the agent's strategic decisions. Due to the contextually dependent nature of the constraint-absorption strand of bilateral power restructuring operations, as well as its proximity in end-results to resource internalization initiatives, the potential for cooptation is the only such tactic included in the framework. The study's RDT-based framework accounting the potential for power restructuring operations is presented in *Figure 5-8*.

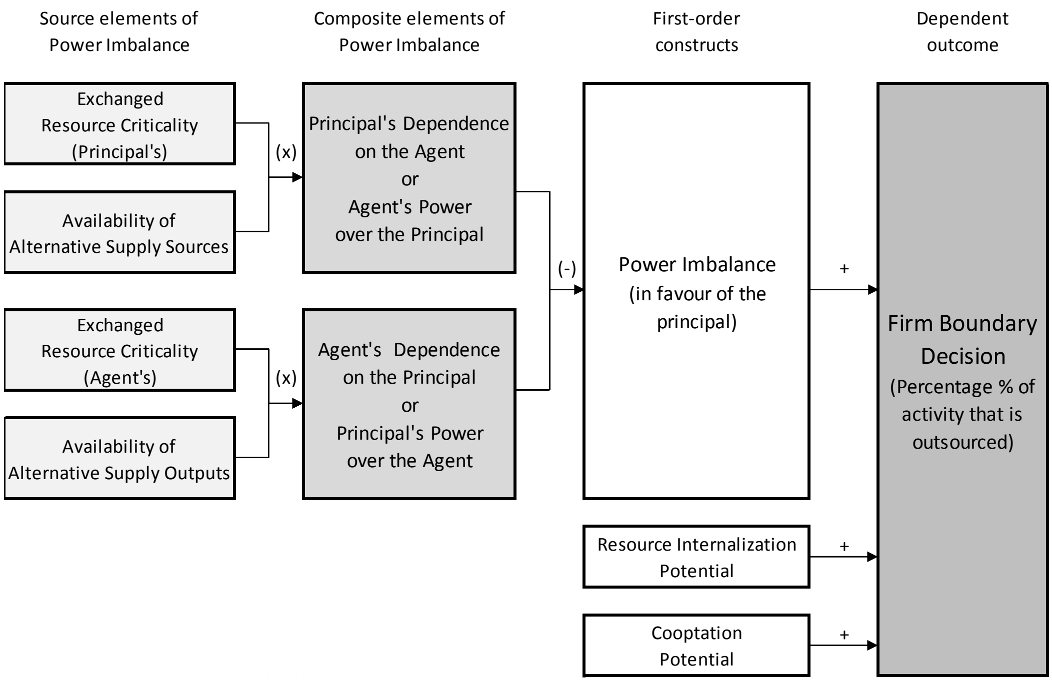


Figure 5-8. RDT framework with the consideration of power restructuring operations

5.4.5 Taking an agent's actual dependence into consideration

Apart from the propositions described in the previous sections with regard to dependency-minded considerations, the study puts forth a final, likely minded, consideration that is posited to further influence, or at least, delineate a focal firm's boundary (i.e. sourcing) decisions. Said consideration refers to the notion of an agent's actual dependence on a focal principal firm and parallels the power restructuring rationale presented in the cooptation potential concept.

In essence, what is being argued is that a constrained principal apart from attempting to create vested interests in an agent through socialization, information sharing and participation in managerial boards, may further do so in a more direct manner by simply accounting for a significant portion of an agent's turnover. In other words, a principal relying on an agent to procure a resource of interest may simply choose to participate in the agent's circle of operations to such a degree that vested interests are created de facto. For example, if one customer of a supplier accounts for 50% of the supplier's operating revenue, then that customer can be de facto considered to be of high importance to the supplier (since the customer's withdrawal would be translated in a 50% reduction of turnover for the supplier). As such, it stands to reason to propose that an agent's vested interests in the maintenance of an exchange relationship increase as a principal's participation to the agent's business increases. Given the foregoing discussion it is put forth that an additional factor that may potentially influence a focal firm's sourcing decisions is the projected impact of its contribution to an agent's circle of operations. As such, the higher that projected impact, the more likely it is that the focal firm will indeed go through with an outsourcing initiative. This notion is portrayed in this study through the concept of an agent's actual dependence on a focal principal, or simply Agent Actual Dependence. *Figure 5-9* portrays the RDT-based framework complemented by this consideration.

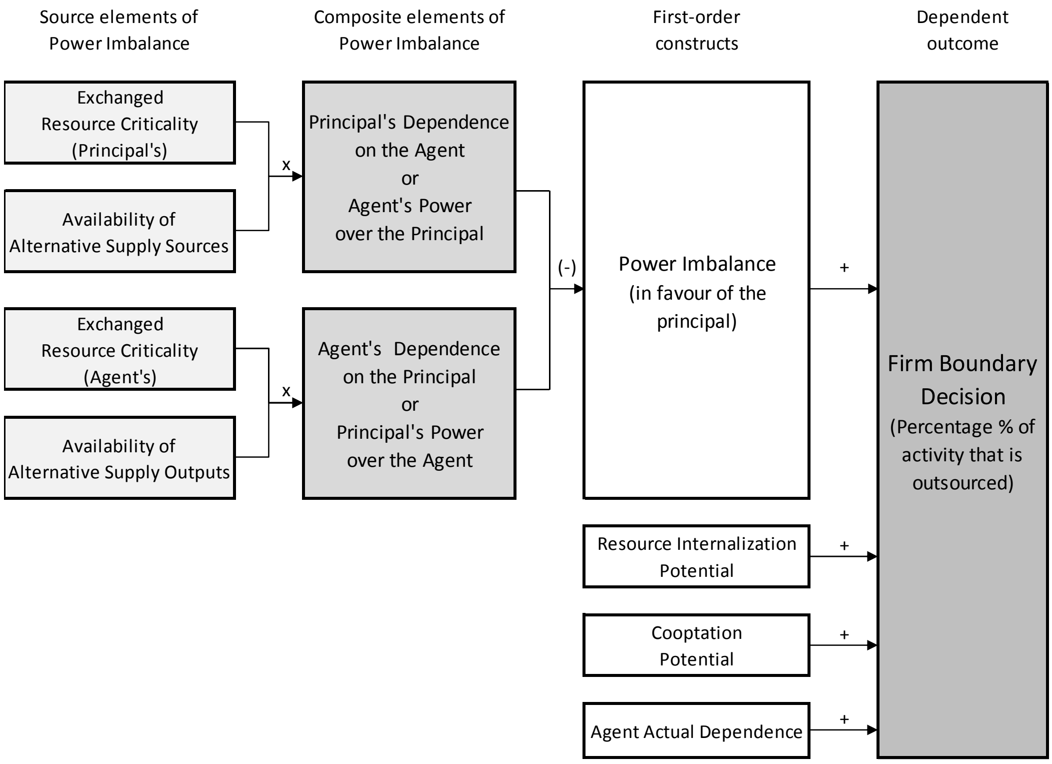


Figure 5-9. RDT framework with the consideration of agent actual dependence

5.4.6 Hypotheses derived from the dependency perspective

Having explored the various considerations put forth by resource dependency theory, the study now derives a series of dependency-based hypotheses slated to be tested in the study's empirical context.

At the heart of RDT's conceptual rationale is the notion of power imbalance. Conceptualized here as the difference between two actor's dependencies (as per Lawler and Yoon, 1996) power imbalance is considered the principle construct informing a focal firm's firm boundary decisions through a dependency perspective. The more favourable the imbalance is towards the principal the more power the principal is considered to have over the agent. In such occurrences, the more likely the principal is to pursue an outsourcing initiative. As such:

H_{RDT1}: The higher the level of power imbalance in favour of the focal firm (principal) is (i.e. the lower the result of the subtraction 'principal's dependence – agent's dependence' is), the more outsourced the focal resource is likely to be.

Subsequently, given the propositions put forth in the previous two sections with regard to the potential for power restructuring operations on behalf of the principal and an agent's actual dependence, the study posits that:

H_{RDT2}: The higher the focal firm's resource internalization potential is (i.e the easier it is to internalize a resource), the more outsourced the focal resource is likely to be.

H_{RDT3}: The higher the focal firm's cooptation potential is, the more outsourced the focal resource is likely to be.

H_{RDT4}: The higher the focal firm agent's actual dependence is, the more outsourced the focal resource is likely to be.

5.5 Competence considerations through a Resource-Based View perspective

Before exploring the Resource-Based View (RBV) perspective, two clarifications are in order. Firstly, as mentioned earlier in section 5.2, in the present study the static RBV framework is treated separately from its dynamic variant, designated as the Dynamic Capabilities Theory. Further to that iterated clarification, it is also noted that the RBV framework reported and utilized in the study is based on the delineating propositions put forth by Peteraf and Barney (2003). Secondly, it should be reiterated that a firm's resource is deemed to denote a tangible or intangible asset that the firm owns, controls, or has access to and from which it potentially derives rents (Helfat and Peteraf, 2003). In turn, a firm's competence is deemed to denote a configuration of resources that enables the firm to accomplish a particular task (ibid). By and large in the current framework, all of the assertions made with regard to a firm's resources are deemed to hold equivalence to a firm's competences as well.

The Resource-Based View of the firm, principally offers an explanation of competitive advantage by using the resource as a unit of analysis and by considering the effects of resource heterogeneity, imperfect mobility and imitation on firm efficiency.

With regard to the explanation of competitive advantage, the principle hypothesis of RBV may be regarded to be that firms, which differ in their resource endowments, exhibit productive efficiency advantages that depend on the efficiency contributions of their resources while the sustainability of said advantages depends on the firms' ability to shield them from imitation.

With regard to the explanation of firm boundaries, the discriminant hypothesis of RBV may be regarded to be that firms, which differ in their resource endowments and ability to shield said resources from imitation, reconfigure their resource portfolio with resources that differ on their productive efficiencies so as to effect a value-maximizing result (Santos and Eisenhardt, 2005).

The roots of RBV may be traced back to Penrose's (1959) conceptualization of firms as collections of productive resources whose future growth depends on their present resource stocks and opportunities for deployment. Wernerflet (1984), subsequently rekindled interest in this perspective, within the field of strategic management, in putting forth that a firm's product market strategy effectiveness depends on its resource endowments. From then on, Barney (1986, 1991) among others (e.g. Amit and Schoemaker, 1993; Peteraf, 1993) initiated the further development and specification of the framework.

5.5.1 Main goal and assumptions of RBV

The Resource-Based View of the firm is primarily occupied by the competitive advantage problem. Summarily, the competitive advantage problem may be described as the problem of determining and implementing firm strategies that maximize the value of a firm's economic activity. Within this mindset, RBV holds that a firm's value is maximized through the utilization of resources that contribute to value creation and are simultaneously scarce.

The contemporary formulation of RBV holds two explicit assumptions. These revolve around the endowments of firms as well as the characteristics of a firm's resources. The first assumption of RBV is *resource heterogeneity*. According to this premise, it is held that resources are heterogeneously (i.e. unevenly) distributed among organizations (primarily due to path dependence and chance) and that organizations have a finite amount resources at their disposal in any given point it time (Peteraf, 1993). The second explicit assumption of RBV, which is also directly linked to the first assumption, is the *imperfect mobility* of resources. This premise basically holds that there are resources that may not be accurately duplicated or their functionality substituted for among organizations (Barney and Hoskisson, 1990). As such, continued resource heterogeneity is ensured.

An important note, rarely expressed in RBV literature, needs to be made at this point. The imperfect mobility of firm resources results from two principle sources. The first, expectedly, is some intrinsic characteristic of the resource that renders it imperfectly mobile such as the fixity of supply of natural resources (Peteraf and Barney, 2003). The second source is the ability of the hierarchical governance structure of a firm to allow for the shielding of resources from imitation either through law (e.g. patents, property rights) or fiat power (e.g. non-disclosure/secrecy agreements) (ibid). Truly, if firms were not able to protect their resources, then those resources would be free to disperse among a product market's occupants and would only be restricted by their intrinsic fixities of supply. Further support for this supposition that hierarchical structures allow for the shielding of resources from imitation, is found in Pitelis's (2009) analysis of the co-evolution and co-determination of the processes of value creation and value capture. In his study, Pitelis (2009) reaffirms Penroses's (1959) concept that the firm structure allows for the development of 'relatively impregnable bases' that in turn allow the organization to better defend and capture the value that it creates.

In addition to the principle assumptions of resource heterogeneity and imperfect mobility, it would be prudent to address a few further assumption related concerns voiced in the literature. Williamson (1999) notes that the competence perspective, as he refers to the collective RBV and DCT literature, implicitly operates under the assumption of bounded rationality largely because it emphasizes the importance of learning. In identifying the learning element of the competence perspective, however, it is argued that within the distinction reported in this study Williamson refers to DCT rather than RBV. Contrary to Williamson's (1999) assertion, it may be argued that the strand of RBV examined in this study (i.e. Peteraf and Barney, 2003) implicitly presumes, at least in part, non-bounded rationality as it operates under the assumption that each firm utilizes its resource endowments to their full potential while also being able to more or less accurately assess their value.

With regard to TCE's assumption of opportunism however, the opposite may be true. On the issue of opportunism, Williamson (1999) asserts that the competence perspective (see caveat in previous paragraph) places emphasis on "the elusive notion of trust" (Gambetta, 1988 p. ix). While that may be true for the Dynamic Capabilities perspective, it may not hold credence for the RBV strand examined here. In the TCE framework, opportunism is regarded as the main reason for the use of contracts (legally binding agreements) as safeguards. Additionally, in TCE, opportunism represents the potential for the exploitation of incomplete contracts. In a nutshell, TCE holds that if there is value exposed in a transaction, then a legally binding contract needs to be enacted in order to safeguard it. If sensibly complete contracts are too difficult to formulate or implement then the transaction needs to be integrated in the firm structure. Therefore in all cases, TCE's notion of opportunism represents the potential for the expropriation of value.

In the RBV framework, value derives from the use of scarce resources. As mentioned previously, the primary necessary and sufficient source of resource scarcity (i.e. imperfect mobility) is the hierarchical structure's ability to safeguard resources that create value from imitation. If a firm's valuable resource is imitated by another firm then its value falls as it is no longer as scarce as it was before being imitated. The resulting value differential, however, does not disappear. It is simply divided among the two organizations that possess it and remains scarce to the extent that there are other firms that would stand to benefit from it. If the resource is imitated across an entire product market space of competing actors, then again its value does not disappear. It is similarly divided evenly among the competing actors and while still allowing for the more efficient implementation of firm strategies, this time it may no longer be regarded as a source of competitive advantage, as its benefits are equally distributed among the firms. Based on the aforementioned premises, it is argued that imitation simply represents an alternative form of value expropriation.

In the case of TCE, value expropriation occurs directly at the level of contract negotiation and indirectly through the costs incurred for post-contractual monitoring and enforcement. In the case of RBV, value expropriation occurs at an elevated tactical level through the process of imitation. In so far as opportunism represents the potential for value expropriation in TCE, and imitation represents the potential for value expropriation in RBV, then it is argued that imitation represents an assumption equivalent to the notion of opportunism. If imitation (an arguably opportunistic behaviour) was non-existent, then there would be no reason for patents and property rights. As such, it is held that RBV also assumes *opportunism* in the form of *imitation*.

Finally, concerning TCE's assumption of human foresight, Williamson (1999) asserts that the competence perspective puts more emphasis on myopia rather than foresight in recognizing that learning takes the form of trial-and-error that relegates the firm from a strategic actor to an emergency-response service. Once again, as is evident from the consideration of learning, Williamson (1999) refers to DCT rather than the RBV strand explored in this section. TCE's assumption of foresight stipulates that actors will attempt to foresee consequences, and will thus engage in actions that lead to more favourable outcomes. In the TCE framework, this assumption principally translates to the economic actor's ability to foresee unfavourable outcomes in a given transaction so as to mitigate them through the formulation of more complete contracts. In the

RBV framework studied here, a firm seeks to maximize its value by modifying its portfolio of resources that create value. In order for this process to work, however, a firm needs to be able to foresee or at least determine which resources augment or diminish its value creation potential. In other words, the firm needs to be able to foresee unfavourable outcomes in a given resource configuration so as to mitigate them through the modification of its resource portfolio. As such, it is held that at least to some extent, RBV also assumes *human foresight*.

The previous discussion offers a platform for the discussion of a further assumption related issue. In TCE, by virtue of bounded rationality, all contracts are incomplete (to various degrees). The ultimate solution of TCE in the incomplete contract problem is the integration of a transaction on a hierarchical structure. If bounded rationality where to be applied in a similar fashion to the present RBV framework, then it would stipulate that all resource configurations devised by a firm would be sub-optimal. That is, that they would never realize their full potential. Nevertheless, the framework assumes that firms are able to recognize the value of factors of production in their disposal and therefore decide whether they should be retained or disposed of (Peteraf and Barney, 2003 p. 316). It is for the same reason that this study recognizes that RBV assumes at least partially, *non-bounded rationality*.

5.5.2 Main propositions of RBV

When viewed from its principle formulation, RBV asserts that firms seek competitive advantage so as to more effectively compete in a given product market space. In the strand of RBV studied in this research, competitive advantage is defined as performance above the marginal (breakeven) competitor in a given product market (Peteraf and Barney, 2003). To explicate the meaning of performance, the framework offers the notion of economic value creation as the basis on which performance is manifested. To that effect, it is stipulated that the economic value created by a firm in the course of providing a good or service is defined as the difference between the perceived benefits gained by the purchasers of the product and the economic cost incurred to the firm (Peteraf and Barney, 2003). Alternatively formulated, RBV asserts that firms seek to maximize their value creation potential in pursuit of growth (Santos and Eisenhardt, 2005). This optimization process is principally conducted through the modification of the firm's resource portfolio, or resource configuration.

At the core of RBV is the premise that certain resources or competences (configurations of resources) allow for better (more efficient) value creation than others (Peteraf and Barney, 2003). Such resources were first described as critical resources (Wernerfelt, 1989) but in the modern RBV framework they are better known (and perhaps deceptively) as valuable resources (Barney, 1991). Based on the premise that such resources allow for the more efficient production of value, the framework holds that whichever firm is in possession of them is granted a competitive advantage over competitors that do not hold them. At this point, it should be noted that the aforementioned concept of critical/valuable resources does not correspond with RDT's concept of critical/essential resources (Jacobs, 1974).

Furthermore, the framework initially stipulated that if these resources, on top of allowing for the more efficient creation of value, are also rare as well as difficult to imitate or substitute for, then they could be considered as sources of sustainable competitive advantage (Barney, 1991). The attributes of rarity, inimitability and non-substitutability were held to embody the ways by which a resource may be imperfectly mobile and thus granted a level of scarcity (Peteraf and Barney, 2003). Nevertheless, more contemporary formulations of the model implicitly downplay the role of non-substitutability as a condition inherently present in the concepts of rarity and inimitability (e.g. Hoopes et al., 2003). The present study ascribes to this line of thought and holds that a resource's scarcity, and inherently its imperfect mobility can be adequately characterized by the two concepts of rarity and inimitability.

Peteraf and Barney (2003), further support this premise in exploring the sustainability of competitive advantages granted by valuable and scarce resources. They underline that a resource of a given value (ability to allow for more efficient value creation) and scarcity will yield a competitive advantage whose sustainability depends on the type of rents produced by the resource. In their exposition, Peteraf and Barney (2003) identify two principle types of rents depending on a resource's susceptibility to imitation.

Primarily, they examine the case where a resource is susceptible to imitation at least in principle. In this case, the added value or rents that derive from the resource are considered to be of a Schumpeterian nature, also known as entrepreneurial rents (Rumelt, 1987), and their longevity is held to depend upon the resource's rate of diffusion in the given competitive product market space (Peteraf and Barney, 2003). As such, to the extent that the rate of diffusion is high, the associated rents as well as the resulting competitive advantage will be short-lived and fleeting. If the rate of diffusion is kept at a minimum (e.g. through strict non-disclosure/secrecy policies) then the competitive advantage may be longer lasting. Prominent examples of such resources are an industry's trade secrets. Given the aforementioned premises and that the type of rent produced depends on the source of a resource's scarcity, it is held that resources susceptible to imitation owe their scarcity primarily to the hierarchical governance structure's (firm's) ability to shield them from imitation. This premise is described in the framework as the variable condition of resource inimitability (alternatively it may be conceptualized as organizationally induced scarcity)**.**

Secondly, Peteraf and Barney (2003) examine the case where a resource is not susceptible to imitation (even in principle). In this case, the authors explicitly recognize that the source of the resource's scarcity is primarily the absolute or relative fixity of its supply. Where there is an absolute fixity of supply (e.g. a finite amount of arable land surface) the added value or rents that derive from the resource are considered to be of a purely Ricardian nature, and their longevity is sustainable indefinitely, bar some unforeseeable development that could either raise the fixity of supply or render them obsolete (Peteraf and Barney, 2003). Relative fixity occurs when the supply of the resource remains limited relative to its demand for some non-trivial period in time (i.e. when there is always more demand than supply). The added value or rents that derive from the resource in this case, are considered as quasi-Ricardian rents, or simply quasi-rents (Peteraf and Barney, 2003). Similarly to purely Ricardian rents, the longevity of the potentially resulting competitive advantage will be sustainable as long as the supply remains relatively fixed. This premise is described in the framework as the variable condition of natural resource scarcity.

To reiterate, the RBV framework utilized in this study holds that resources that are valuable rare and inimitable are considered as sources of competitive advantage. Furthermore, the sustainability of said competitive advantage is held to depend on the level of resources' rarity and inimitability. Rarity is considered to be a source of imperfect mobility when there are exogenous restrictions in the resources supply base (i.e. restrictions not related with managerial action) and is characterized as a higher-order construct termed *resource rarity*. Inimitability, in turn, is considered as a source of imperfect mobility imposed due to a firm's ability to shield resources from imitation and is characterized by the higher-order construct termed *resource inimitability*.

5.5.3 Discriminating resource attributes

To describe a resource's contribution to the more efficient creation of economic value, the framework utilizes the term *Resource Value*. In line with the present RBV logic, a resource is deemed valuable if it allows the firm to create value more efficiently than the marginal (breakeven) competitor in a given product market (Peteraf and Barney, 2003). In adopting Brandenburger and Stuart's (1996) framework of value creation, Peteraf and Barney (2003) essentially equate a resource's value with its contribution to higher gains and/or lower costs.

In the first case, the resource is deemed to contribute to higher gains if it somehow increases the perceived benefits or willingness to pay (WTP) of the focal firm's customers by a premium over the willingness to pay of the product market's marginal (breakeven) competitor. WTP in this RBV framework coincides with Brandenburger and Stuart's (1996) definition of the term as the economic value at which the customer perceives the decision to pursue the purchase of the offered good or service to be on par with the decision of not pursuing the transaction. In other terms, it represents the threshold economic value at which the customer becomes indifferent towards the prospect of pursuing an economic exchange.

In the second case, the resource is deemed to contribute to lower costs if it somehow allows for the more economic production of a good or rendering of a service by the focal firm when compared to the market's marginal (breakeven) competitor. In finalizing the report on resource value, It should be underlined that a resource may potentially contribute to the more efficient creation of value (and thus be regarded valuable) by promoting both higher gains as well as lower costs. The two ways by which a resource may be deemed to be valuable do not exclude each other in any way.

As mentioned in the previous section, the immobility (or imperfect mobility) of a resource is considered as the product of two sources: (a) the characteristic inherent scarcity of the resource (embodied by the fixity of its supply) as well as (b) the shielding effects of the hierarchical governance structure. The reported RBV framework ascribes *Natural Resource Scarcity* as the attribute describing the first source of imperfect mobility and *Resource Inimitability* as the distinguishing characteristic of the second source. Resource inimitability in turn is held to be the product of three further characteristics defined as *Unique Historical Conditions, Social Complexity* and *Causal Ambiguity* (Barney, 1991).

With regard to natural resource scarcity, it is an attribute held to account for the size of a resource's supply base by querying the availability of the resource (or the availability of assets potentially leading to the resource) in factor markets (Peteraf and Barney, 2003). At this point, it is acknowledged that this formulation does not account for the dynamic progression of a resource's supply base. It merely captures, as it were, the present state of affairs. A more thorough approach could attempt to capture, or somehow account for, the elasticity of a resource's source of supply. Such an approach, should examine whether the supply is absolutely fixed, relatively fixed (i.e. constrained) or simply dependent on the resource's rate of diffusion in a given product market space. Despite this deficiency, the present RBV framework still accounts for rate of diffusion of a resource by considering the attribute of resource inimitability. This equation stipulates that the harder it is to imitate a resource, the lower its rate of diffusion is going to be.

Resource inimitability is considered to comprise three constructs: *Unique historical conditions*, s*ocial complexity* and *causal ambiguity*. The unique historical conditions construct represents the model's acknowledgement of path-dependency. Path dependency is, in essence, the recognition that firms are intrinsically historical and social entities and that their ability to reconfigure their resource portfolio depends upon their place in time and space (Barney, 1991). As such, it is held that certain valuable and rare resources may find their way in the hierarchical governance structure of a firm due to the firm's unique path through history (ibid). Given that said resources are inherently rare, or that their formation and value-enhancing properties strictly depend on a particular path through history, then they could be shielded from imitation as competing firms that have not followed the same particular path, will be unable to do so ex post facto. Resources commonly ascribed to fit this description include property-based resources such as land ownership deeds and exploitation rights (e.g. in mining/drilling) as well as patents, copyrights and trademarks (Crook et al., 2008).

Similarly, a resource is deemed to be protected from imitation by virtue of unique historical conditions if its scarcity is derived from its acquisition or development in particular space and time-dependent circumstances that cannot be replicated in the present or foreseeable future. This attribute of resource inimitability is usually not expanded into further formalized comprising attributes and is considered on a case-by-case basis mainly due to the unique nature of the resources involved. Nevertheless, given that the general underlying construct is that of scarcity, it is proposed that indicators of the resource's uniqueness may be consulted to further inform the analysis and perhaps allow the evaluation of the resource's supply base constraints. Crook et al. (2008) further propose that resources subject to time compression diseconomies (Dierickx and Cool, 1989), meaning resources that take time to accumulate and cost more to accumulate faster, could also meaningfully be included for consideration within this attribute.

Social complexity is held to characterise resources that result from very complex social phenomena that are beyond the abilities of firms to systematically manage and influence (Barney, 1991). Such resources are deemed to include a firm's organizational culture and customer base, the interpersonal relations that managers form as well as a firm's reputation (ibid). The rationale behind this attribute is that while a resource's beneficial effects may be well understood, a systematic approach towards its attainment and replication cannot be either conceptualized or enforced. Therefore, the resource is held to be shielded from imitation by virtue of social complexity, and is thus granted a level of scarcity depending on how difficult it is to replicate. Nevertheless, since the attribute's premises were first articulated, management research has progressed to the point where similar socially complex phenomena previously deemed unmanageable, have become the focus of new management techniques (e.g. Dasu and Chase, 2010; Hoffman and Fodor, 2010). In light of the above, and much like the attribute of unique historical conditions, social complexity has thus far not been expanded into further formalized comprising attributes and should be, yet again, considered on a case-by-case basis.

The final and perhaps more important, or at least more developed, resource inimitability attribute, is causal ambiguity (Alchian, 1950; Reed and DeFillippi, 1990). Causal ambiguity is held to represent the case where the causal relationship between a firm's resources and its impact on performance (or competitive advantage manifestations) is not clearly understood (Barney, 1991). As such, a resource is deemed to be shielded from imitation, by virtue of causal ambiguity, if the process by which it enhances value remains obscure. Therefore, the resource is granted a level of scarcity because competing firms are unable to determine exactly what set of assets and procedures should be replicated. Contrary, to the previous two resource inimitability attributes, the mechanisms and further constituent attributes of causal ambiguity have recently been subjected to further conceptual development. King (2007) offers such an exposition and the propositions set forth are taken into consideration in this study to inform the causal ambiguity condition. *Figure 5-10*, illustrates the basic RBV framework in explaining firm boundary decisions.

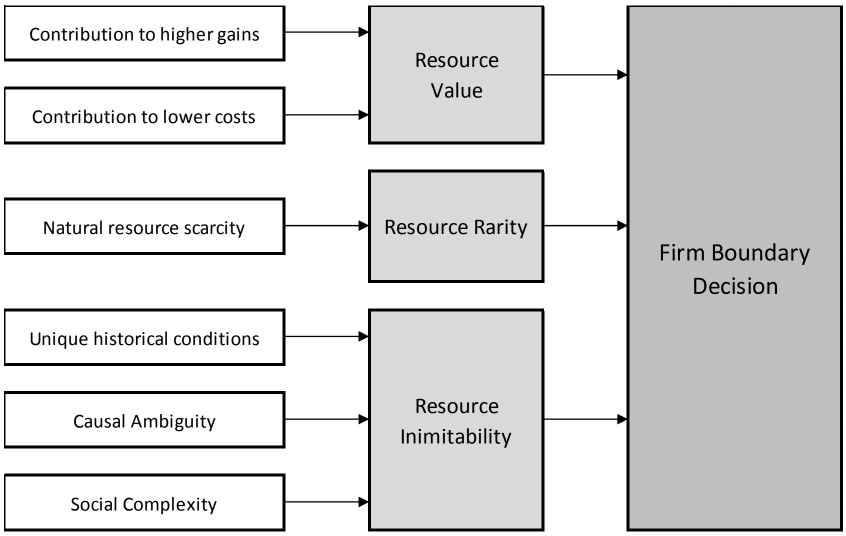


Figure 5-10. Basic Resource Based-View of the firm framework of firm boundary decisions

Having reported the three main constituents of RBV's resource inimitability attribute, it is now easier to conceptualize the way with which the hierarchical governance structure of a firm acts as a source for the imperfect mobility of resources and artificially creates scarcity through barriers to imitation. In the case of unique historical conditions, the hierarchical governance structure comprises an organizational entity that is sometimes inherently better positioned to take advantage of historically unique opportunities.

In some cases, it may offer the unified yet multi-skilled platform of economic action that is oftentimes legally necessary for the bestowment of certain resources. For example, public natural resources (or the exploitation thereof) may only be awarded in the hands of private enterprise when a sufficient set of necessary competences are present. At other times the firm structure may be granted amplified rights over individuals or other organizational forms in matters of property, copyright and patent law, and thus allow for the more effective shielding of resources from imitation.

In the case of social complexity the hierarchical governance structure offers the necessarily intricate organizational form upon which socially complex phenomena may be developed. In a biological simile drawing from the formation of coral reefs on appropriate substrates, this governance form acts as the substrate necessary for the formation of such socially complex phenomena. Finally, in the case of causal ambiguity, the hierarchical governance form offers the opacity necessary for masking a resource's value enhancing mechanisms.

5.5.4 Delineating and operationalizing causal ambiguity

In her meticulously refined framework, King (2007) distinguishes between intrafirm and interfirm causal ambiguity. Intrafirm causal ambiguity represents the ambiguity present among a focal firm's decision makers. Interfirm causal ambiguity, in turn, represents the ambiguity developed between the focal firm and its peer competing firms. Informing the concepts of intrafirm and interfirm causal ambiguity is a series of varying firm and resource characteristics. Beginning with resource related characteristics King (2007) puts forth *Resource Complexity, Resource Tacitness, Resource Interconnectedness* as well as *Resource Distance to Performance* as attributes held to exacerbate intrafirm and interfirm causal ambiguity.

Resource complexity refers to the level to which a resource is dependent on the complex interaction of human and technological systems. As such, the more a resource relies on combinations of interdependent human and technological systems, the more difficult it is to establish causality both within as well as outside the focal firm (Reed and DeFillippi, 1990; Makadok and Barney, 2001; King, 2007).

Resource tacitness refers to the conscious or unconscious nature of the activities comprising a resource and essentially inquires the level of definitional clarity surrounding the resource. As such, the more tacit or unconscious the activities surrounding a resource, the more difficult it is to establish causality both within as well as outside the focal firm (Simonin, 1999; King and Zeithaml, 2001).

Resource interconnectedness refers to the level to which a resource is connected interactively with other resources in the focal firm. King (2007) holds this attribute to influence primarily interfirm rather than intrafirm causal ambiguity as a focal firm's decision makers have unique knowledge about the firm's operations that are not readily available outside the firm's structure (Reed and DeFillippi, 1990). As such, the more specific or interconnected a resource is with the focal firm's other resources, the more difficult it is to establish causality outside the focal firm (Teece et al., 1997; King, 2007).

Finally, resource distance to performance is an attribute that, drawing from psychology and philosophy nomenclature, King (2007) refers to as cues to causality. In essence, this attribute refers to the spatial and temporal distance between a given resource's use and the observation of its value enhancing contribution. As such, it is put forth that the further away a resource is from readily observable performance patterns, the more difficult it is to establish causality both within as well as outside the focal firm (King, 2007). Consequently, the attribute is held to amplify both interfirm as well as intrafirm causal ambiguity.

Subsequently moving on to firm characteristics, King (2007) puts forth the cognitive and motivation related properties of the focal firm's decision-making units as an attribute capable of moderating intrafirm causal ambiguity. This arguably complex nomenclature is labelled here as a *Focal Firm's Perceptiveness*. In similar fashion, the cognitive and motivation related properties of the other competing firms' decision-making units is held by King (2007) as an equivalent attribute capable of reducing interfirm causal ambiguity. Again, in the interest of parsimony, this attribute is labelled here as *Competitors' Perceptiveness.* In a nutshell, these last two attributes hold that the more motivated and cognitively engaged the decision-making units of an organization are, the more likely they are to overcome the conceptual obscurities imposed by causal ambiguity, and thus moderate it.

Another piece to the causal ambiguity puzzle is finally offered by King (2007) in the form of *Interfirm Differences*. This institutionally-based attribute refers to the organizational and cultural distance between competing firms (Simonin, 1999) and is deemed to amplify the level of interfirm causal ambiguity. Organizational distance refers to the level of differences observed in business practices and organizational culture between competing firms while cultural distance refers to differences in national culture and language (King, 2007). As such, the further apart, in terms of organizational and ethnic culture, a competing firm is from a focal firm commanding a valuable resource, the higher the level of interfirm causal ambiguity.

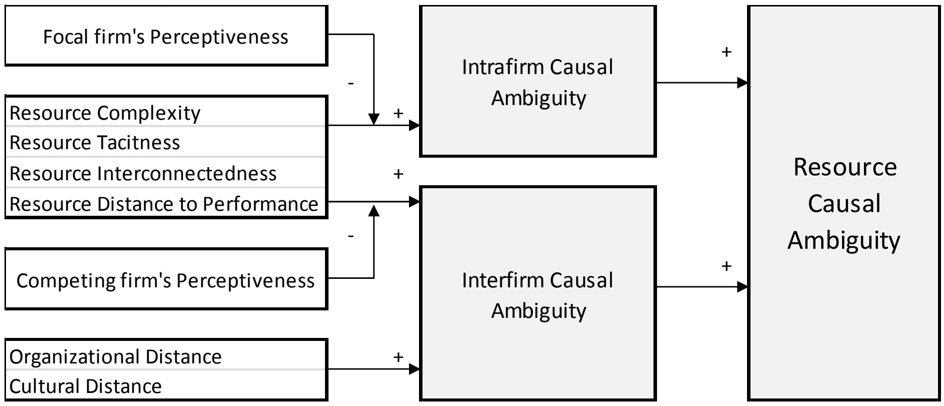


Figure 5-11. Causal ambiguity as delineated by King (2007)

Though exhaustively inclusive and detailed, King's (2007) delineation of causal ambiguity is, nonetheless, deemed markedly too complex to be meaningfully included in its entirety within the RBV-based framework utilized in this study of servitization (*Figure 5-11*). As such, the study opts to refrain from further considering the issues of perceptiveness (of the focal and of any given competing firms), as well as the issues of organizational and cultural distance. Such detailed (and admittedly hard to empirically ascertain) considerations, though thoroughly insightful, are considered to fall outside the scope of the aims of this research.

Nevertheless, it is supported that a number of the propositions put forth by King (2007) could helpfully inform the study's RBV-based framework by ascribing a specific content to the operationalization of a resource's causal ambiguity in the form of intrafirm and interfirm causal ambiguity along with some of their posited constituent elements. In particular, those elements associated with specific resource characteristics such as resource complexity, tacitness, interconnectedness and distance to performance. In assigning each of these characteristics to a specific causal ambiguity type, given the foregoing discussion, resource complexity, tacitness and distance to performance are held to primarily influence intrafirm causal ambiguity, while resource interconnectedness is held to primarily influence interfirm causal ambiguity.As such, the RBV-based framework complemented with a more refined view of causal ambiguity is presented in Figure 5-12.

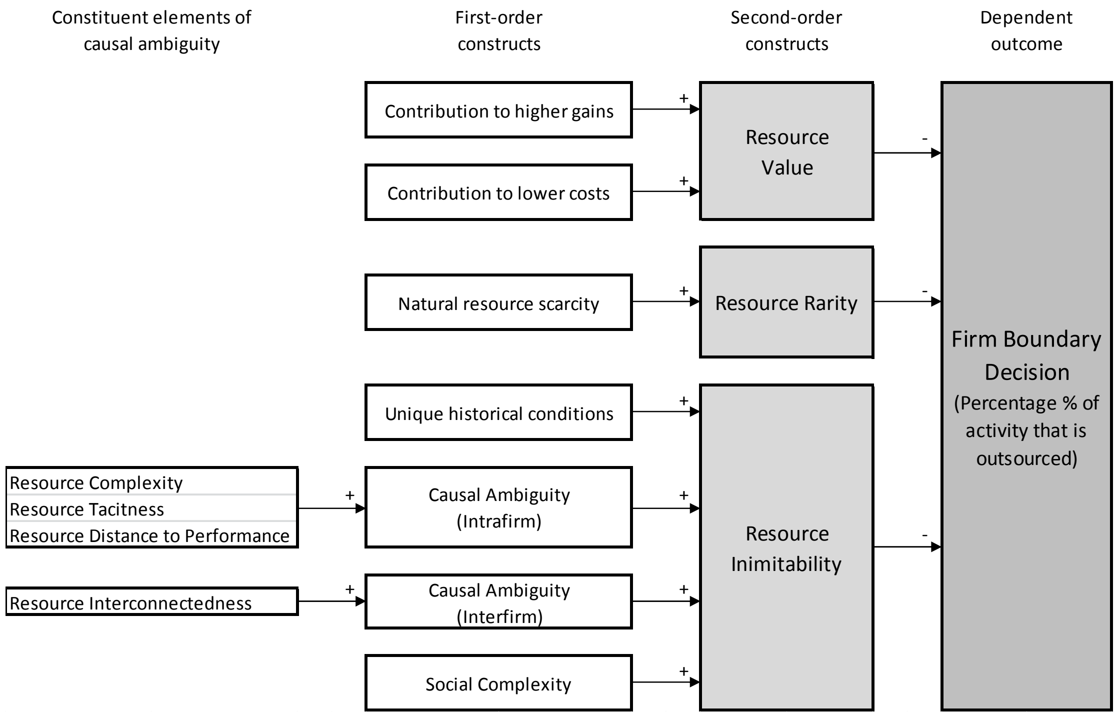


Figure 5-12. RBV-based framework with a delineated view of causal ambiguity

5.5.5 Accounting potential future value contributions

A final consideration that is put forth, in addition to the ones already reported within the RBV-based competence perspective, is that of future value contributions by the resource in question. In essence, what is being advocated is that given human foresight, a focal firm may also take into account the potential that a resource may hold in contributing to higher gains or lower costs in the future. In other words, it is put forth that while a resource may not be considered immediately valuable, and thus should be discarded (outsourced), it could nonetheless be deemed to be a potential source of higher gains and/or lower costs, and thus competitive advantage, for the firm in the future.

This dimension to the concept of a resource's value is dubbed here Potential Resource Value and is considered to consist of two constituent elements covering the resource's potential contributions to higher gains as well as lower costs. The construct, thus, is deemed to operate much in the same way that the construct of Resource Value is structured. The study's RBV-based framework with the inclusion of this final consideration is presented in *Figure 5-13*.

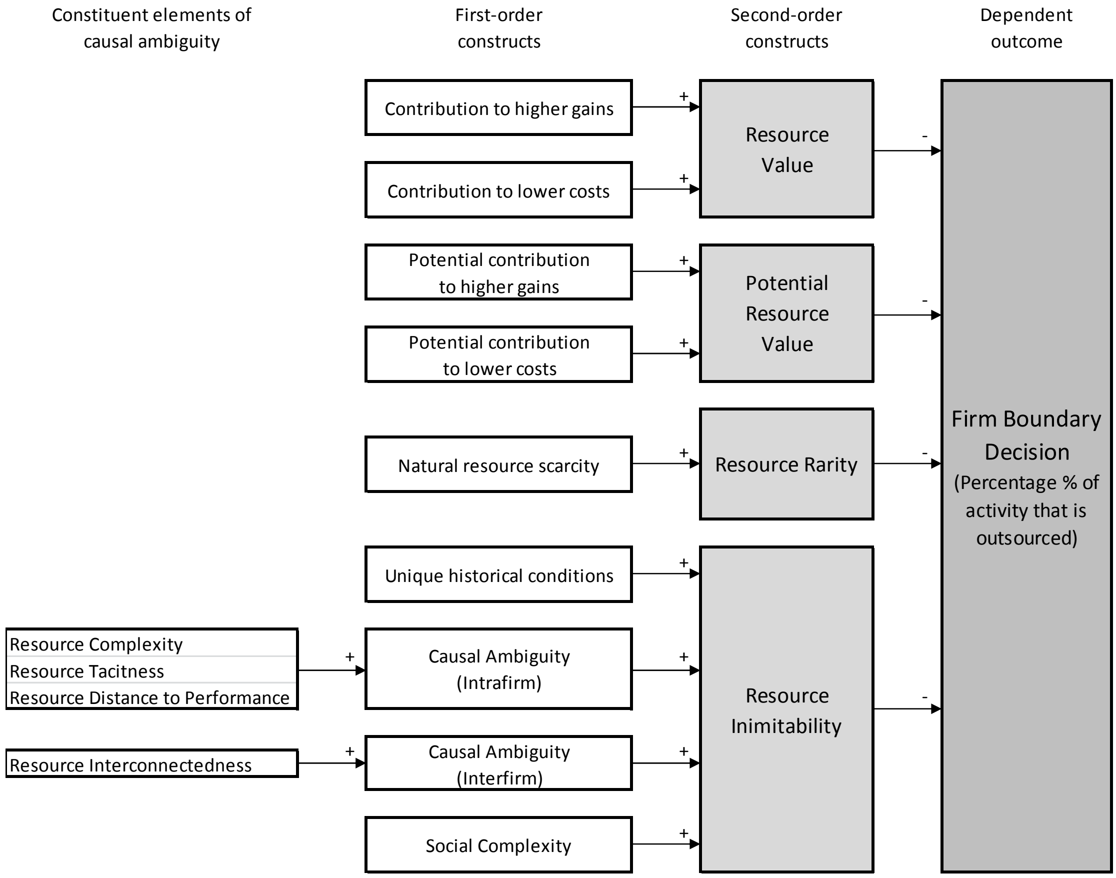


Figure 5-13. The RBV-based framework with the inclusion of Potential Resource Value

5.5.6 Hypotheses derived from the competence perspective

Having explored the various considerations put forth by the resource-based view of the focal firm, the study now derives a series of competence-based hypotheses slated to be tested in the study's empirical context.

The primary discriminating attribute put forth by this study's RBV-based framework is that of Resource Value. According to the framework, the more valuable a resource is considered the less likely it is to be outsourced. More specifically, by taking into account the study's conception of value as contributions to higher gains and/or lower costs for the firm, the following first two hypotheses are formed:

H_{RBV1}: The higher a focal resource's contribution to higher gains is, the less outsourced the resource is likely to be.

H_{RBV2}: The higher a focal resource's contribution to lower costs is, the less outsourced the resource is likely to be.

Though introduced late in the exposition of RBV related competence considerations, the issue of Potential Resource Value is considered next. The reasons for this prioritization stem from the same arguments that hold the Resource Value attribute at the top of the list. If a resource is not deemed valuable, or in this case at least potentially valuable, the attributes of rarity and inimitability have little to offer in any further deliberations. As such, in line with the propositions put forth in the previous section:

H_{RBV3}: The higher a focal resource's potential contribution to higher gains and/or lower costs is, the less outsourced the resource is likely to be.

With regard to a resource's potential value contributions the hypothesis is formed in a singular way so as to warrant that the construct refers to perceptions of future states that are more ambiguous, and thus more difficult to discern, when compared to perceptions of current states.

Moving on to the intrinsic attribute of resource rarity, articulated in the framework through natural resource scarcity, the following hypothesis is formed:

H_{RBV4}: The higher a focal resource's natural scarcity is, given a non-trivial level of current or potential resource value, the less outsourced the resource is likely to be.

Finally, focus is put on the attribute of resource inimitability conceived in the framework to consist of causal ambiguity (both intrafirm and interfirm), social complexity and unique historical conditions. Bundled together as a variety of mechanisms through which a resource's value or causation to competitive advantage is obscured (in the case of causal ambiguity and social complexity) or perhaps becomes unattainable (in the case of unique historical conditions), this complex attribute is held to stem the hypothesis that:

H_{RBV5}: The higher the level of a focal resource's inimitability is, given a non-trivial level of current or potential resource value, the less outsourced the resource is likely to be.

5.6 Identity considerations through Organizational Identity Coherence

An alternative rationale to the more traditional approaches of TCE, RDT and RBV was recently brought to light by Santos and Eisenhardt (2005) in the form of the Organizational Identity Coherence (OIC) perspective. This framework offers an explanation of vertical integration and firm boundaries by using the attribute of identity as a unit of analysis and by considering the effects of bounded rationality, environmental complexity and sensemaking on organizational identity coherence.

The discriminant hypothesis of this perspective is that organizations that differ in their perceived organizational identity, integrate resources (or activities), which differ in their identity attributes, so as to ensure resource-identity coherence.

The OIC framework, owes its conceptual foundation to two theoretical strains of organizational behaviour (Santos and Eisenhardt, 2005). The first is the managerial cognition literature stream (Prahalad and Bettis, 1986; Weick, 1995), while the second inspiring literature stream is that of organizational identity (Albert and Whetten, 1985; Elsbach and Kramer, 1996). The managerial cognition literature explores the ways with which a firm's decision makers utilize specific cognitive frames in order to make sense of the business environment and take action, while the organizational identity literature focuses on the ways with which specific values and norms are formed and shared within an organization and ultimately bestow it with a distinct identity (Santos and Eisenhardt, 2005).

5.6.1 Main goal and assumptions of OIC

In essence, the perspective holds that firms may have distinct organizational identities with which the firm's decision-makers identify. Furthermore, it is also held that resources potentially considered for integration (for whatever reason) may also be ascribed by the same decision makers with an identity attribute. The given resource's identity attribute then, may be found to coincide with or differ from the firm's perceived identity. Within these premises, the framework holds that the extent to which a resource's identity coincides with the perceived identity of the firm largely determines whether the resource will be deemed appropriate for integration or not. As such, it is put forth that the more aligned the considered resource's identity attribute is to the firm's perceived identity the more likely the firm is to integrate it. Conversely, the more distant or alien the resource's identity attribute is considered to be with the firm's identity, the less likely the firm is to integrate it.

The OIC Perspective conceptualizes organizations as social contexts for sensemaking. Sensemaking is perceived as the process by which members of the organization contextualize and interpret circumstances (Weick, 1995). As such, it includes the way with which organizational members receive new information, interpret prior actions, converge on the meaning of changes in the organization's environment, and finally determine the appropriate courses of action (Santos and Eisenhardt, 2005). Finally, the framework holds that organizational members pursue a collective form of sensemaking (Weick, 1995), in order to achieve consensus and be able to better respond to extra-firm challenges. One of the reasons for the need of such a collective sensemaking process is considered to be the inability of individual members to fully conceptualize and analyse extra-firm challenges. With said limitations assumed, the Organizational Identity perspective holds the assumption of *bounded rationality* (Santos and Eisenhardt, 2005).

Adjunct to the assumption of bounded rationality, the OIC framework further holds the assumption of *environmental complexity* (Santos and Eisenhardt, 2005). Through this premise the perspective recognizes that an organization's environment exhibits increased levels of complexity, which coupled with individuals' bounded rationality, essentially gives meaning to the need for collective sensemaking. According to the framework's premises, to cope with environmental complexity, reduce ambiguity, and facilitate decision making, collective sensemaking tends to crystalize into specific cognitive frames (ibid). Cognitive frames, may be considered as the prevailing sets of assumptions, preconceptions and modes of thought within an organization that guide action and act as information filters with regard to what is relevant, important and response-worthy (Bettis and Prahalad, 1995). Once cognitive frames are established, they are held to provide cognitive as well as emotional coherence and guide an organization's subsequent actions (Bogner and Barr, 2000).

If shared and communicated throughout the organization, cognitive frames are held to form the building blocks of organizational identity (Santos and Eisenhardt, 2005). Apart from conscious managerial action, however, the framework recognizes that the institutional environment in which the organization operates may affect the formation of cognitive frames and hence an organization's identity (ibid). In other words, it is held that the prevailing institutions that make up an organization's contextual environment may have an active role to play in the creation, evolution and even destruction of the organizations identity. As such, further to bounded rationality and environmental complexity, it is argued that the organizational identity coherence framework purports the assumption of *institutionalism*.

5.6.2 Main propositions of OIC

With regard to the issue of firm boundary decisions, the OIC perspective holds that the litmus test through which organizational members determine whether or not to internalize a resource or activity is its coherence with the established organizational identity (Santos and Eisenhardt, 2005). In other words, it is put forth that a firm's decision makers perceive what is and what is not appropriate for the organization through identity (Kogut, 2000). Thus, identity is held to dictate which value-chain activities should be internalized or not. The deceptively simple OIC framework is presented in *Figure 5-14*.

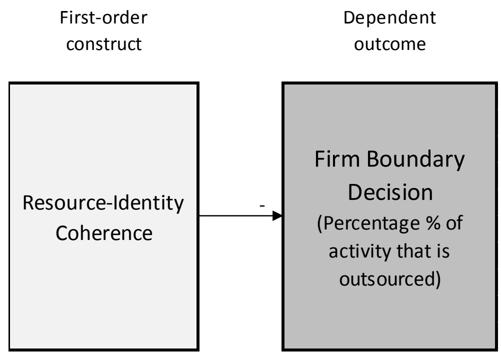


Figure 5-14. Basic Organizational Identity Coherence framework of firm boundary decisions

According to the framework, identity may be imprinted on a firm upon its initial formation as a result of the founder's pre-existing beliefs and conceptions or as a corollary of the existing institutional environment (Baron, Burton and Hannan, 1999; Santos and Eisenhardt, 2005). Further to the initial forming circumstances, it is held that identity may evolve over time through the firm's interactions with the rest of the industry (Porac et al., 1995) and the institutional environment (Gioia and Thomas, 1996) or simply through the intrafirm interactions of the firm's members. Finally, a firm's organizational identity may also be susceptible to change in the face of failure (Siggelcow, 2001). In such a premise, if the firm survives, it is held that the organization's identity may change to reflect the identity attributes of the activities or strategies that led to the firm's survival (ibid).

According to the arguments put forth by the OIC framework, identity may conditionally be either a competitive strength, or a competitive weakness (Santos and Eisenhardt, 2005). Identity may be a competitive strength if it offers focus and differentiation benefits while further inspiring emotional attachment among employees and customers (Rindova and Fombrun, 2001). On the other hand, a strong identity may stem a whole suite of potentially inhibiting effects that may render it a competitive weakness. Identity is formed out of crystallized cognitive frames that reflect a firm's taken-for-granted aspects of operations, strategy and behaviour. As such, identity embodies the status quo or otherwise an establishment to which members unconsciously become emotionally attached over time. That emotional attachment, however, makes members particularly resistant to change. As such, members may ignore, reject, misinterpret or even hide information that threatens the organization's self-concept (Brown and Starkley, 2000).

Consequently, identity may lead a firm to forfeit the consideration of new avenues of development or even more importantly ignore clear and present threats to its survival.

5.6.3 Influences beyond resource-identity coherence

Apart from the resource-identity coherence proposition, it is held that the organizational identity framework may have at least one further insight to provide, in explaining firm boundary decisions. Earlier, in the discussion covering the framework's premises on the forming and evolutionary mechanisms of identity, it was reported that a firm's identity may be influenced by its interactions with the rest of the industry as well as interactions with its institutional environment (Santos and Eisenhardt, 2005). The industrial environment is deemed to include the business sector's collective firm associations, industry leaders as well as key competitors. The institutional environment then is considered to include the industry's regulatory bodies or other key contextual business entities that may be held to yield influence on the focal firms, by nature of their relation to the industry, while not directly competing with them. As such, it is may be argued that industrial and institutional influences to a firm's boundary decisions are, conceptually, already included in the model through the organizational identity construct.

Nevertheless, it is argued here that it would be profitable to also account for the influence of institutional and industrial forces to a firm's boundary decisions separately. The rationale behind this inclusion is that the separate account of such forces may allow the model to discern the level of self-determination exhibited by firms in boundary decisions. In other words, it would provide further insights towards the extent to which a firm's boundary decisions are the product of independent managerial action or external forces largely outside of its sphere of control. In line with the aforementioned premises, the operationalization of the organizational identity perspective includes the constructs of *Institutional Forces Influence* and *Industrial Forces Influence*. *Figure 5-15*, illustrates the proposed OIC framework.

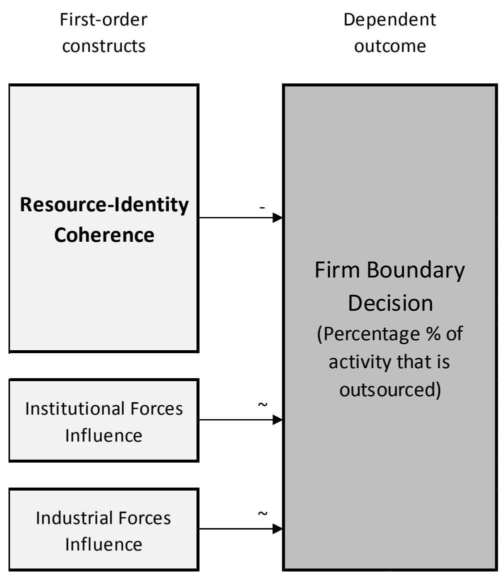


Figure 5-15. OIC framework with the consideration of external influences

5.6.4 Hypotheses derived from the identity perspective

Having explored the various considerations put forth by the organizational identity coherence perspective, the study now derives its series of identity-based hypotheses slated to be tested in the study's empirical context.

The primary discriminating attribute put forth by this study's OIC-based framework is that of resource-identity coherence. According to the framework, the more congruent or aligned a resource is with the focal firm's established identity the less likely it is to be outsourced. As such, the main hypothesis stemming from the OIC framework is:

H_{OIC1}: The higher the level of a focal resource's alignment with the organizational identity of a focal firm is, the less outsourced the resource is likely to be.

With regard to the additional issue of external forces influence, there is no a priori direction towards which the constructs influence may be hypothesized. In other words, dependent upon the particular activities or resources under consideration and the external forces' disposition towards the sourcing of said activities, these influences may drive the focal firm towards either direction. However, what could be hypothesized is that the stronger the influence, the more pronounced the directionality of the sourcing decision is likely to be. As such the relevant hypotheses could be stated as:

H_{OIC2}: The higher the level of the institutional forces influence is, the higher the impact to the focal firms' sourcing decisions is likely to be.

H_{OIC3}: The higher the level of the industrial forces influence is, the higher the impact to the focal firms' sourcing decisions is likely to be.

Chapter 6

The empirical context

6.1 Introduction

The previous chapter, reported extensively on the principle considerations that are thought to influence a customer firm's decisions with regard to the sourcing of activities targeted by servitized offerings. The exploration of multiple modes of strategic thought (efficiency, dependence, competence and identity) yielded a variety of propositions seeking to explain a customer firm's sourcing behaviour in varying states, attributes and characteristics of the activities being considered. Having largely completed this study's theoretical considerations with regard to the phenomenon of interest, this chapter identifies an empirical context where the aforementioned propositions and thereof derived hypotheses may be further explored and tested in an experimental manner. The chapter begins with an exposition of the study's requirements for a suitable empirical context and subsequently reports on the election and particulars of the empirical context finally selected.

6.2 Requirements of a suitable empirical context

6.2.1 Basic requirements

To identify a suitable empirical context for the further exploration and testing of the propositions and hypotheses formed in the study, principle reference is made to the basic premises identified to be necessary for the manifestation of the servitization of manufacturing phenomenon and, in particular, the variant of transactional servitization. These basic premises were first introduced in the chapter describing the case of performance-based contracts and are further reiterated here to assist the identification of a suitable empirical context.

In brief, these basic requirements include:

- The existence of firms operating in a free-market business environment
- A particular need akin to the firms' business activities that needs to be satisfied
- That the need may be satisfied through the functionality of a particular known-to-the-world technological artefact
- That the technological artefact is based on established and mature technologies rather than novel or disruptive new technologies

Within this, only somewhat restricting, frame of empirical contexts a multitude of alternative settings may be considered. Nevertheless, in the interest of productivity, it is asserted that in addition to the forerunning requirements an additional indispensable ingredient is:

- The existence or active promotion of transactionally servitized offerings to the focal firms in question, in the form of performance-based contracts

This last basic requirement is deemed necessary given the study's research questions. Indeed, it would be fruitless to examine an empirical setting where transactional servitization has not yet begun to emerge as its generative mechanisms could be considered to lay dormant, or otherwise not-actualised, and thus remain unobservable.

6.2.2 Additional practical requirements

In addition to the basic necessary requirements described in the previous sub-section, a series of further optional yet advantageous requirements of a more practical nature are further considered. These requirements chiefly include two unrelated yet equally important issues. The first relates to the research approach adopted in the study (a variance-based model of inquiry) while the second relates to certain desirable characteristics of the technological artefact around which servitization initiatives are formed.

With regard to practical requirements relating to issues of the study's research approach, two such requirements are identified:

- That there are enough observable and accessible occurrences of the study's dependent variable for statistical inference
- That the empirical context allows for the restriction of spuriousness or otherwise provides an increased control for the elimination of rival hypotheses

In translating the aforementioned requirements in more practical terms, the first requirement relates to the need for the existence of a sufficient population of independent outcomes for the dependent variable (in this case the outsourcing of activities targeted by transactionally servitized offerings) in order to conduct statistical analysis procedures. This means that the empirical setting should accommodate the existence of a sufficient number of firms that face the firm-boundary dilemma described in the chapter portraying the case of performance-based contracts. This requirement, would thus exclude settings were oligopsonies are observed on the receiving end of servitization initiatives (e.g. military supply contracting settings).

In addition to the existence of a sufficient number of such occurrences, it is further needed that these occurrences may be rendered accessible to the study. Through this stipulation, it is implied that certain empirical contexts are less accessible than others by a PhD level individual study such as the one presented in this thesis. For example, a probing of energy producers in their needs for the functionality of power generating technological artefacts may be hindered due to access issues originating from national security concerns. Though in a different setting than that of the energy sector, the author is acquainted with a case where access issues retroactively discontinued a similar research programme due to such considerations.

Moving then to the second requirement relating to the study's variance-based nature, it is the case where an empirical setting is deemed more desirable if it allows for the restriction of spuriousness, or otherwise enables better control of alternative explanations to the study's hypotheses. While the issue is addressed more lengthily in the study's methodological chapter it is referenced additionally here since it further pertains to the optional requirements of a suitable empirical context. The issue of spuriousness relates to the existence of extraneous factors that may confound the causal relationships hypothesized in a study (Van de Ven, 2007). In other words, it relates to factors that may potentially influence the outcome of interest while not directly being articulated and tested within the study's boundaries. Such extraneous factors may be considered to include a multitude of contextual conditions that relate to a variety of sources, some of which may be conceivable while others may remain outside the researcher's perceptual ability due to bounded-rationality issues.

Nevertheless, it is asserted that a, perhaps large, number of such confounding extraneous factors may be effectively controlled for through the election of particular empirical contexts. For example, in choosing firms from a specific and well-defined business sector with specific core product offerings that bear few bleeding influences or interactions with other business sectors could be suggested as an effective way to control for cross-industry or cross-product differences that could yield confounding extraneous factors. Additionally, as cross-market confounding factors may emerge as different geographical markets may command their own respective contextual idiosyncrasies (national, cultural, or other), the election of a globalized market industry could further facilitate in controlling such influences.

Given the foregoing discussion, it is asserted that a large number of extraneous factors potentially influencing the study's hypothesized causal relationships could be controlled for if the elected empirical setting:

- Contains firms that operate in a singular well-defined industrial business sector rather than many different ones
- That the industrial business sector's core product offering is relatively isolated from that of other business sectors
- That the core product offering is globalized, or otherwise homogeneously attractive across multiple geographical markets

Finally, concerning the second practical issue relating to the characteristics of the technological artefact, the issue is directly related to the importance of the artefact to the focal firms' continued mode of operations. In essence, this requirement stipulates that the technological artefact, and most importantly its functionality, should be sufficiently important to the focal firm so that the activities related to it are consciously considered as issues worthy of investigation as to whether they should be outsourced or not. In other words, the technological artefact in question should be worthy of deliberate managerial preference at a strategic level. Usually, this issue relates to the relative monetary importance of the artefact. In line with this reasoning, the more fiscal resources are dependent upon the artefact's functionality the more important the artefact is considered, and thus, is more likely to be the object of deliberate managerial preference.

6.2.3 Election of the empirical context: The deep-sea shipping industry

Given the previously stated requirements, this sub-section reports the study's elected empirical context that is held to accommodate all of the basic, necessary as well as additional practical stipulations. The empirical context elected is that of the international deep-sea shipping industry. Otherwise referred to as the marine freight industry it is the sector of economic activity consisting of revenues generated from the transportation of freight cargo by ship throughout the world's seas. Within this empirical context, the focal firms of interest and potential customers of servitization initiatives are individual marine shipping companies engaged in the international transportation of dry and wet cargo (crude-oil, fuel and chemical products, bulk cargos, containers, etc). To confirm the appropriateness of the elected empirical context, one need only review the particular business sector's characteristics against the necessary and optional requirements stated in the previous sections.

Primarily, the business environment in which marine shipping companies operate can undeniably be attested to be a free-market economic environment. Subsequently, marine shipping companies, by virtue of the nature of their principle business activity (i.e. transporting cargo from point A to point B through the seas), rely on complex engineering systems (large seafaring vessels) to conduct their operations. In recognizing these engineering systems as technological artefacts in and of themselves, it is identified that shipping firms have particular business needs that may be satisfied through the functionality of at least one type of known-to-the-world technological artefact.

These complex engineering systems, however, are aggregate platforms of a finite variety of individual industrial technological artefacts – each serving a particular purpose – that are all necessary for the viable operation of the ship as a whole. For instance, heading and track control systems serve the need of navigating the intended course, radar systems serve the need of ensuring awareness of the ship's immediate surface environment, and propulsion systems serve the need of rendering motion to the ship, and so on. Therefore, a shipping firm employing the functionality of a ship is held to simultaneously employ the functionality of the various technological artefacts that make up the vessel as a whole and render it seaworthy. Moreover, the vast majority of these technological artefacts are based on well-established and mature technologies with multiple decades of development history. Consequently, shipping companies are identified as firms having multiple particular business needs that may be addressed through the functionality of multiple technological artefacts. Finally, as will be witnessed further along the chapter, performance-based contracts (i.e. transactionally servitized offerings) though nascent, are offered for a variety of a ship's engineering systems.

Secondly, with regard to the additional practical requirements of the empirical context, the marine freight sector appears to fit remarkably well. With a world fleet of over 100,000 commercial seagoing ships (over 1,000 DWT) in service by the turn of 2011 (UNCTAD, 2011) there are at least a few thousand marine shipping companies around the world providing an extensive proving ground for any study based on statistical inference. Additionally, accessibility concerns are addressed in a number of ways. The marine freight sector is an economic environment heavily geared towards the satisfaction of industrial and commercial needs around the world with no particular concerns for national security interests or the like. Furthermore, the existence of a variety of international shipping firm associations facilitates the implementation and coordination of variance-based research programmes. On a last note on the point of accessibility, it should further be mentioned that by virtue of the author's past experience as an intern engineer in an international shipping firm, the study's accessibility and contextual knowledge barriers are further lowered.

Finally, with regard to the issue of controlling extraneous factors that could confound the study's hypothesized causal relationships, the deep-sea merchant marine sector offers multiple advantages. With relatively few exceptions, marine shipping firms exhibit little diversity in terms of their core business activities, product offering and markets addressed. They all provide point-to-point cargo transportation services the world over and they all operate under the same international regulatory environment (e.g. the International Maritime Organization's rules and regulations). Additionally, by virtue of the globalized nature of sea-trade they are all simultaneously subject to the same global economic climate.

6.3 Focal technological artefact targeted by servitization

Having identified a suitable empirical context, the study further needs to identify a particular technological artefact targeted by servitization efforts to act as the focal object of interest in the study's empirical inquiries. As mentioned in the previous section, marine shipping firms are in need of the functionality of a variety of engineering systems in order to conduct their business. Furthermore, many of these systems are at the core of servitization and servitization-like initiatives.

6.3.1 Election of the technological artefact: A ship's main propulsion engine

The study considered a number of engineering systems for the research's purposes. These included the ship's radar and sonar electronic sensory equipment, the ship's bridge integrated Command-and-Control systems as well as the ship's main propulsion engines. In each case, archival sources were conferred to verify the existence of transactionally servitized offerings. Additionally, face-to-face meetings and/or telephone contacts were performed in order to ascertain the suitability of utilizing each engineering system in the bounds of the study.

For one reason or another, the cases of the ship's radar and sonar electronics as well as the bridge's integrated C&C systems were dropped in favour of the ship's main propulsion engines. In the case of the bridge's C&C systems, it was acknowledged that the industrial product was still relatively nascent in its development and diffusion all the while not being an invaluable piece of technology for the day-to-day operations of a shipping firm. Additionally, recognized predominantly as a multiple supplier systems integration effort rather than a single manufacturer endeavour, it was thought that such a context would burden the study with unnecessary complexity.

In the case of the ship's radar and sonar sensory equipment, the engineering system was turned down principally due to its diminutive monetary importance in relation to a shipping firm's day-to-day operations. After a number of meetings with radar manufacturing and shipping firm executives, it was clear that while the system is an essential and necessary part of a ship's seaworthiness, its cost requirements rendered it more an expendable rather than service-worthy piece of technology. As one shipping firm executive put it: "At a $5,000 to $10,000 price tag, or even a $20,000 one, you just throw it away and get a new one."

In the case of the ship's main propulsion engines (or rather engine, as there is usually only one main engine on-board), none of the concerns reported in the previous paragraph are raised. The technological artefact in question, resoundingly in some form of a two-stroke low-speed marine diesel engine, is a sine qua non piece of equipment for any seafaring vessel transporting cargo that has enjoyed decades of development and maturity both as a piece of technology as well as a product offering (Figures 6-1 and 6-2). Additionally, the end artefact is by and large the product offering of a single manufacturer responsible for its assembly while related servitization efforts in the form of performance-based contracts have been in the market at least since 2007 (MAN Diesel, 2007).

Figure 6-1. A 75,000 bhp two-stroke low-speed marine diesel engine on transport

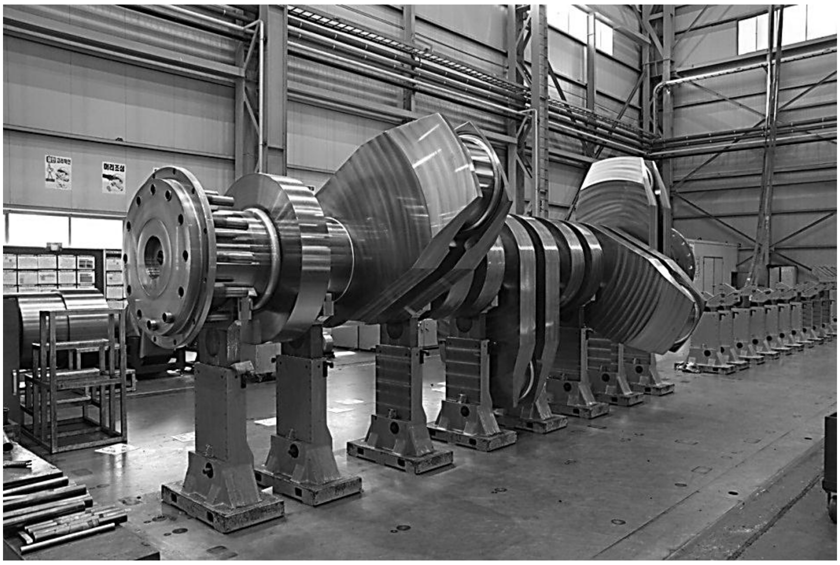


Figure 6-2. Crankshaft of a two stroke low-speed marine diesel engine

Finally, the particular technological artefact exhibits exceptional levels of monetary importance for a shipping firm for a variety of reasons. On the one hand, as large engineering complexes, propulsion engines (or otherwise prime movers) make up a significant amount of a newly built ship's price tag (in the range of 5%-7% of the overall ship-building cost). Furthermore, their key components usually remain on-board for the entirety of the ship's operational lifecycle. As such, they are not susceptible to whole replacement but rather a series of scheduled or unscheduled service, spare part replacement and remanufacturing regimes. On the other hand, and most importantly, they influence a shipping firm's day-to-day operations to a highly significant degree. If a prime mover breaks down in the middle of a voyage, each passing day brings numerous contractual contingency clauses in effect that diminish a shipping firm's profit making potential (losses in the range of several thousand dollars per day). Finally, with fuel costs being the single largest cost driver in the operation of a large vessel (in the range of $35,000 to $60,000 worth of bunker fuel for a single day's voyage) (Hatzigrigoris, 2011), a malfunctioning or ill-tuned prime mover can be a major source of operating losses. Given the foregoing discussion, the issue of whether to insource or outsource activities related to the ensured functionality of the particular technological artefact are thought of as primary candidates for managerial discretion at the highest level.

6.3.2 On the artefact's business ecology and servitization attempts

The development and manufacturing of large two-stroke low speed marine diesel engines celebrated its centennial anniversary in 2012 (marked by the launch of the *Selandia* in 1912). With a century of competitive market history, this particular manufacturing segment is survived in the present by only three main designer/licensors, namely, MAN Diesel, Wärtsilä (Sulzer) and Mitshubishi Heavy Industries (Woodyard, 2009). Principally due to its niche nature and specialized technological parameters the competitive market of prime mover marine diesel engines always numbered its participating competitors in the low double-digits. Renowned manufacturers of old included companies whose name still remains active in other manufacturing fields: AEG-Hesselman, Deutsche Werft, Doxford, Fullagar, Götaverken, Krupp, McIntosh and Seymour, Neptune, Nobel, North British, Polar, Richardsons Westgarth, Still, Stork, Tosi, Vickers, Werkspoor and Worthington (ibid.). Even though this marine shipping supplying segment of manufacturing always numbered a limited amount of individual suppliers, the miniscule number of surviving designer/licensors that appears today unmistakably characterizes the segment as an oligopoly.

With rising development costs and large installed bases of industrial products with long lifecycles, the development of servitized offerings in this sector was only a matter of time. According to industry archival sources, servitized offerings in the form of performance-based contracts appeared within this sector near the mid to later years of the previous decade (MAN Diesel, 2007). Such offerings are self-described as “full maintenance management” or “asset management” programs that cover all maintenance needs and guarantee high availability (ibid.; Wärtsilä, 2010).

Several distinguishing characteristics can be identified in the contracts. The offerings commonly include a complete coverage of the maintenance cycle ranging from schedule planning to the provision of original spare parts and manpower for any arising needs. Furthermore, within the manufacturers' marketing pitch, emphasis is put on the increasing technological complexity of the capital equipment which the manufacturers are posited to be in a better position to manage by virtue of their nature. Moreover, reference is made to beneficial synergies arising from having the whole of the maintenance function managed “under one roof”. Finally, it is indicated that these offerings may be available on the basis of five, ten or fifteen year contracts where a fixed monthly rate is set as a payment for the “total-care” services rendered.

Of particular interest, however, is the acknowledgement on behalf of manufacturers -through the same archival sources- that this line of offerings marks a “departure in maintenance programs in that these have traditionally been conducted by ship owners/operators…” (MAN Diesel, 2007). At this point, it is primarily evidenced that the servitized offering does not seek to introduce new value unbeknownst to the various industry partners, but rather to restructure the governance of related transactions through the outsourcing of the maintenance function to the manufacturers. In parallel to this recognition from the manufacturers' side, the same view is adopted almost unanimously by the potential customers. Indeed, for most managers interviewed within the bounds of the study, the question of how to view and examine performance-based contracts was almost a non-issue. The implicit assumption was that everyone perceives it to be a call to outsource.

6.4 Focal activities targeted by transactionally servitized offerings

Having identified an appropriate technological artefact situated at the core of servitization initiatives, the study further needs to identify a series of particular activities that are specifically targeted by transactionally servitized offerings. To identify these activities, the research was informed by a variety of industry archival sources such as technical manuals and brochures all the while being consulted by a key number of shipping firm technical executives. These last contextual informants included two Technical Directors from two different marine shipping firms, an experienced freelance seafaring 1st Engineer as well as a marine engine manufacturing firm executive. In addition to these principal sources of information, the author's own technical expertise as an Industrial Engineer aided the identification, classification and definition of these activities.

All of the identified activities can be construed to fall under the unifying concept of main engine maintenance. As such, they are considered to address the third basic functionality issue related with the satisfaction of a focal firm's business need through the functionality of a particular technological artefact (Fig.6-3) (see Chapter on the case of Performance-Based Contracts).

Figure 6-3. Focal activities identified in relation to the three basic functionality issues

These main engine maintenance activities, by virtue of their intended purpose, are subsequently divided in two principle categories or functions. Namely, they are considered to fall under the auspices of either Planned Maintenance or Non-Planned Maintenance. In short, through the term Planned Maintenance what is implied is activities relating to the maintenance of a ship's main propulsion engine though preventative maintenance procedures and regular interval service operations. In turn, through the term Non-Planned Maintenance what is implied is activities relating to the repair of a ship's main propulsion engine in the case of failure, malfunction or some other sort of incident that entails unexplained poor performance.

Within the cadre of the aforementioned principle maintenance functions, three respectively similar activities per maintenance function are recognized to be at the core of the technological artefact's servitization initiatives. Generally speaking, they involve a three stage remedying process that includes: (1) the diagnosis or planning stage of the problem or issue at hand, (2) the provision of spare parts for the intended procedure, and (3) the actual performance of the service or repair operation. Figure 6-4 summarily reports the focal activities identified to be targeted by transactionally servitized offerings in the study's particular empirical context.

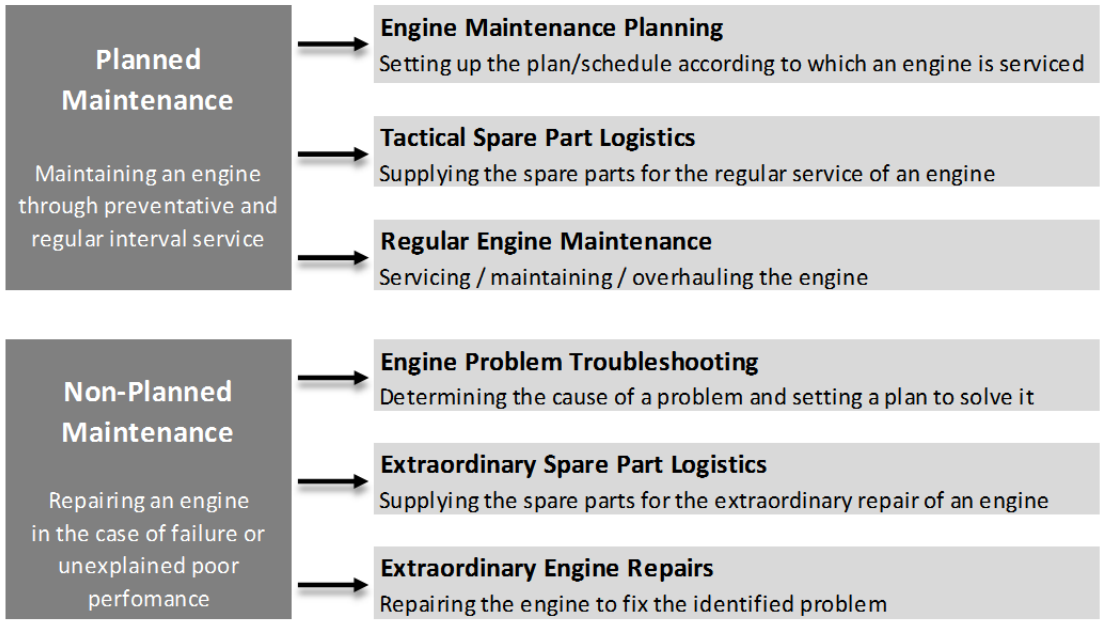


Figure 6-4. Focal activities targeted by servitized offerings in the study's empirical context

In more detail, the final identified activities of interest include:

With regard to the Planned Maintenance function:

1. *Engine Maintenance Planning*: an activity involving the process of setting up the plan and/or schedule according to which a firm's ship engines are to be serviced and/or overhauled

2. *Tactical Spare Parts Logistics*: an activity involving the logistical supply of spare and/or other parts needed for the regular (or otherwise pre-intended) service or overhaul of an engine

3. Regular Engine Maintenance: an activity that involves the actual performance of the planned service or overhaul operation on a ship's main engine

With regard to the Non-Planned Maintenance function:

4. *Engine Problem Troubleshooting*: an activity that involves the actions necessary for the determination of the cause of an engine-related problem (diagnosis) and subsequently the establishment of a plan to solve it

5. *Extraordinary Spare Part Logistics*: an activity that involved the logistical supply of spare and/or other parts needed for the extraordinary repair of an engine

6. Extraordinary Engine Repairs: an activity that involved the actual performance of the repair operation intended to remedy the problem identified

6.5 Potentially confounding extraneous factors of the empirical context

Having identified a series of particular activities that are specifically targeted by transactionally servitized offerings, this section finally attempts to identify a series of issues or factors that could potentially confound the causal relationships hypothesized through the different strategic perspectives under scrutiny in this research. In other words, the section seeks to identify certain lines of reasoning outside the study's hypothesized considerations that could potentially influence the empirical inquiry's outcome of interest (i.e. an activity's sourcing decision) in the chosen empirical context.

6.5.1 A marine shipping firm's size

Traditionally in organizational research as well as studies of sourcing decisions, a prime candidate for inclusion in such a process is the focal firms' size (e.g. Gray, Roth and Tomlin, 2009; Broedner, Kinkel and Lay, 2009). As such, it is hypothesized that the larger or smaller a marine shipping firm is could potentially be a factor that influences its sourcing decisions. The reasoning behind this supposition can be viewed in a variety of ways ranging from resource munificence to industrial forces influence. To paradigmatically illustrate just these two lines of reasoning, with regard to resource munificence one could suppose that smaller marine shipping firms lack the human, fiscal, knowledge or other resources necessary to sustain an in-house technical department that could handle the activities identified in the previous section. As such, the smaller the firm the more outsourced the focal activities could be construed to be. In the case of industrial forces influence, it could be supposed that in the given empirical context smaller firms traditionally do not entertain the presence of an in-house technical department not for any other reason rather than due to tradition and precedence. As such, given that firms might be influenced by their competitive environment and further exhibit mimetic behaviour, then smaller firms might be anticipated to outsource the focal activities to a higher degree than larger firms.

6.5.2 A marine shipping firm's age

Parallel to the issue of firm size, another factor that could potentially influence a firm's sourcing decisions could be the firm's age. As such, one might expect that older firms may exhibit different behaviour than that of their younger counterparts. In this case, organizational inertia (Hannan and Freeman, 1977; 1984) could, perhaps, offer some compelling arguments as to why such a difference in behaviour might be observed. Older firms might at some point in the past have actively considered and deliberated on the issue of whether or not to outsource the focal activities of the study. Reasonably, a decision was made given the then prevailing circumstances. Since then, however, the issue might not have been revisited in light of new or emerging circumstances. Nevertheless, younger firms might have been faced with the issue at a time when the novel circumstances had already emerged, and were thus lead to make a different decision. One justification for the older firms' behaviour might be that they still consider their decision valid in light of the new circumstances. Another position might hold that due to organizational inertia, they continue on the same path because 'that's the way things have been done around here'. In any case, the argument is made that a firm's age might potentially influence a firm's current sourcing positions.

6.5.3 A marine shipping firm’s ship average age

A final piece to this series of potentially confounding extraneous factors of the empirical context, and one that is particularly specific to the empirical setting elected might be the shipping firm’s age of ships operated. In this case, it is considered that shipping firms with older ships might exhibit different behaviour than firms with younger examples. A line of reasoning behind this assertion might be that firms that prefer the operation of older (and perhaps perceived as cheaper) ships feel comfortable in using them due to their unique knowledge resources on how to deal with operational issues associated with older ships that deter other firms from preferring them. In such a case, these firms might favour the insourcing of maintenance activities in an attempt to leverage the same knowledge resources in order to save on costs. On the other hand, a less complicated line of reasoning might hold that firms that prefer older ships simply do not have the fiscal or other resources to accommodate the procurement and operation of new-buildings. Consequently, it would be reasonable to hypothesize that the same firms equally do not have the resource means to support an in-house technical department and thus favour the outsourcing of maintenance activities. In any case, it is deemed profitable to control for a firm’s average age of ships as a potentially confounding extraneous factor influencing sourcing decisions.

Chapter 7

Methodological foundation of the research

7.1 Introduction

This chapter elaborates on the study's methodological foundation. Specifically the chapter articulates the study's research questions and boundaries as well as the research approach and research design adopted to answer the research questions. Additionally, the chapter elaborates on the study's population of interest, sampling frame and a host of related requirements of the research.

7.2 Research questions and boundaries

This section elaborates on the research questions posed by the study in order to address a specific research gap identified in the academic discourse on servitization. Furthermore, the section delineates the research's specific boundaries with regard to the conceptual frameworks held to inform, or otherwise, assist in the issue of addressing the study's research questions.

7.2.1 Research gap and resulting research questions

Archetypically, transactional servitization in the form of performance-based contracts is best known through Rolls-Royce's 'power-by-the-hour' offering for aircraft engines. Through that offering, instead of once and for all selling the engine, the maker seeks to charge airline companies on an engine thrust output basis over each flight-hour logged by a plane. Variations of this model may include arrangements where the customer 'leases' the capital equipment's functionality on a calendar time basis or on some other relevant metric representing usage or output.

The corollary of such revenue models, however, is that the customer firm is asked to hand over the management of all maintenance and any other auxiliary operations exclusively to the manufacturer's care while essentially purchasing the functionality of the capital equipment (engine) on a usage regime. The rationale behind the strategy is that it enables the manufacturer to automatically capture any value from 'downstream' after-sales activities (e.g. consultancy, maintenance and training) and to lock the customer firm in a continuous relationship that additionally yields relatively more stable revenue streams.

While the model's appeal to the manufacturer seeking further growth may be obvious, this study contests that the model's appeal to the customer firm is strikingly ambiguous. That is to say that while the manufacturer has a lot of strategic reasons to try and transactionally servitize its offerings, why would the customer firm want to be locked up in a continuous relationship? Why would it want to give up on its existing technical competences and hand over all operations to the manufacturer?

As underlined in Chapter 4, previous research on servitization is markedly silent on this point having primarily focused on the manufacturer's point of view. Past studies have predominantly been occupied with the operational ways with which manufacturers may make their way towards transactionally servitized offerings all the while assuming that the demand for such offerings is a given fact (see sub-section 4.2.2). As such, a research gap is identified in the study of servitization from the customer firm's strategic point of view.

Having identified this research gap, the study adopts a strategic management perspective towards the study of transactional servitization, and attempts to uncover the conditions under which the strategy is more or less likely to be received positively by its target audience. In other words, the study seeks to identify the strategic conditions under which the potential customers of transactionally servitized offerings are more or less likely to accept them.

To facilitate the uncovering of these conditions, the study examined what the acceptance of such offerings actually means for the customer firm in section 4.3. Upon comparing traditional product offerings with transactionally servitized offerings, the study found that the latter require customer firms to outsource a particular set of activities that were traditionally handled by them. In other words, it was found that the decision to accept or reject such offerings poses a make-or-buy or firm boundary decision problem to the customer firm with regard to the activities targeted by the offerings. Given this premise, the acceptance of servitized offerings is equated with the willingness (or propensity) to outsource said activities. As such, the study's guiding research question is narrowed down to the following:

RQ: Which strategic considerations influence a customer firm's decision to outsource or not activities targeted by transactionally servitized offerings?

Having identified that the acceptance or rejection of transactionally servitized offerings depends on the customer firm's insourcing or outsourcing preferences over a particular set of activities, the study was further informed by the outsourcing/make-or-buy literature with the aim of uncovering the strategic logics or considerations that influence a company's firm boundary decision to insource or outsource a given set of activities.

The review of said literature lead to the identification of four principle strategic considerations: Efficiency (cost considerations), Dependency (autonomy considerations), Competence (growth considerations) and Identity (coherence considerations). Each one of these perspectives represents a different strategic logic that highlights different imperatives deemed to influence a company's sourcing decisions. Efficiency underlines the need for cost minimization, Dependency puts forth the need for autonomy and self-reliance, Competence considers requirements for competitiveness and growth while Identity maintains the importance of coherence within an organization.

Given these findings, the study then operationalizes the research question through the following sub-questions:

RQ1: Which efficiency considerations influence a customer firm's decision to outsource or not activities targeted by transactionally servitized offerings?

RQ2: Which dependency considerations influence a customer firm's decision to outsource or not activities targeted by transactionally servitized offerings?

RQ3: Which competence considerations influence a customer firm's decision to outsource or not activities targeted by transactionally servitized offerings?

RQ4: Which identity considerations influence a customer firm's decision to outsource or not activities targeted by transactionally servitized offerings?

7.2.2 Research boundaries

Having identified four particular strategic logics that could potentially influence a customer firm's sourcing decisions, the study was then faced with the issue of articulating and operationalizing the rather abstract considerations of efficiency, dependency, competence and identity as a variety of meanings, interpretations and contents may be ascribed to each one.

To overcome this difficulty, and given the finite amount of resources available to this study, a particular theoretical paradigm was elected for each one to serve as the basis for its operationalization and study. As such, efficiency was operationalized through the lens of transaction cost economics, dependency through the guise of resource dependency theory, competence through a particular strand of the resource-based view of the firm, while identity is approached through propositions put forth by Santos and Eisenhardt (2005).

Subsequently, each overarching strategic consideration was articulated into a specific conceptual model by compiling the relevant constructs observed in each theoretical paradigm's extant literature. As a result, four discrete conceptual models were developed in order to help explore a customer firm's decisions through the four identified strategic considerations. With the aid of these conceptual models each theoretical paradigm then yielded a series of testable hypotheses with regard to the considerations that influence a customer firm's propensity to outsource or not activities targeted by transactionally servitized offerings. These hypotheses, subsequently, outline the study's research boundaries with regard to which issues are addressed and which are not. To further facilitate the demarcation of this study's boundaries, the hypotheses involved are reiterated here and are further graphically portrayed in the ensuing graphs depicting the study's testable models.

Boundaries in efficiency considerations

The study's boundaries with regard to the efficiency perspective of a firm's sourcing decisions are marked by the following hypotheses derived from the operationalization of the perspective through transaction cost economics:

H_{TCE1}: The higher the level of behavioural uncertainty is, the less outsourced the focal transaction is likely to be.

H_{TCE2}: The higher the level of the principal's asset specificity is, the less outsourced the focal transaction is likely to be.

H_{TCE3}: The higher the level of the principal's proprietary asset exposure is, the less outsourced the focal transaction is likely to be.

H_{TCE4}: The higher the level of the agent's asset specificity is, the more outsourced the focal transaction is likely to be.

H_{TCE5}: The higher the level of the agent's proprietary asset exposure is, the more outsourced the focal transaction is likely to be.

H_{TCE6}: The higher the level of market/volume uncertainty is, the less outsourced the focal transaction is likely to be.

H_{TCE7}: The higher the level of technological uncertainty is, the less outsourced the focal transaction is likely to be.

H_{TCE8}: The higher the level of the value assessment ability is, the more outsourced the focal transaction is likely to be.

H_{TCE9}: The higher the level of the contribution assessment ability is, the more outsourced the focal transaction is likely to be.

H_{TCE10}: The higher the level of transaction frequency is, the less outsourced the focal transaction is likely to be.

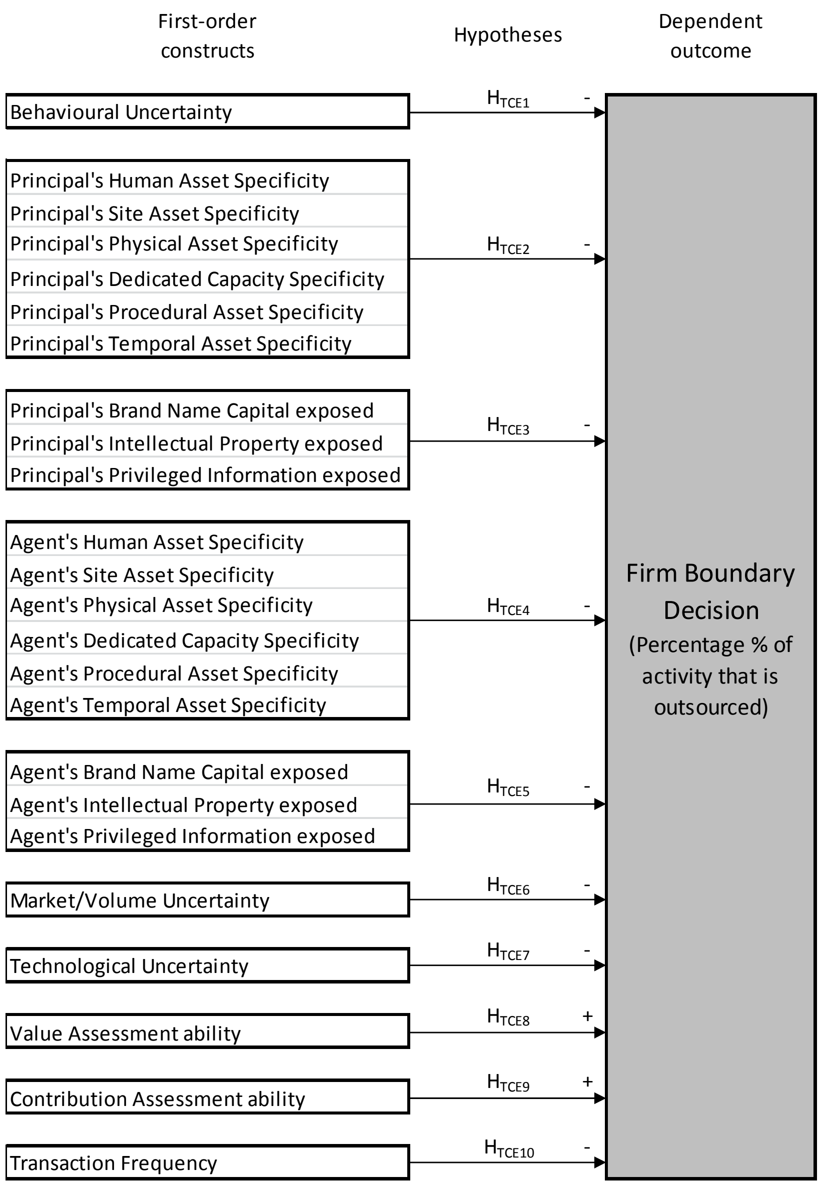


Figure 7-1. Hypotheses from the efficiency perspective through transaction cost economics

Boundaries in dependency considerations

The study's boundaries with regard to the dependency perspective of a firm's sourcing decisions are marked by the following hypotheses derived from the operationalization of the perspective through resource dependency theory:

H_{RDT1}: The higher the level of power imbalance in favour of the focal firm is, the more outsourced the focal resource is likely to be.

H_{RDT2}: The higher the focal firm's resource internalization potential is (i.e the easier it is to internalize a resource), the more outsourced the focal resource is likely to be.

H_{RDT3}: The higher the focal firm's cooptation potential is, the more outsourced the focal resource is likely to be.

H_{RDT4}: The higher the focal firm agents' actual dependence is, the more outsourced the focal resource is likely to be.

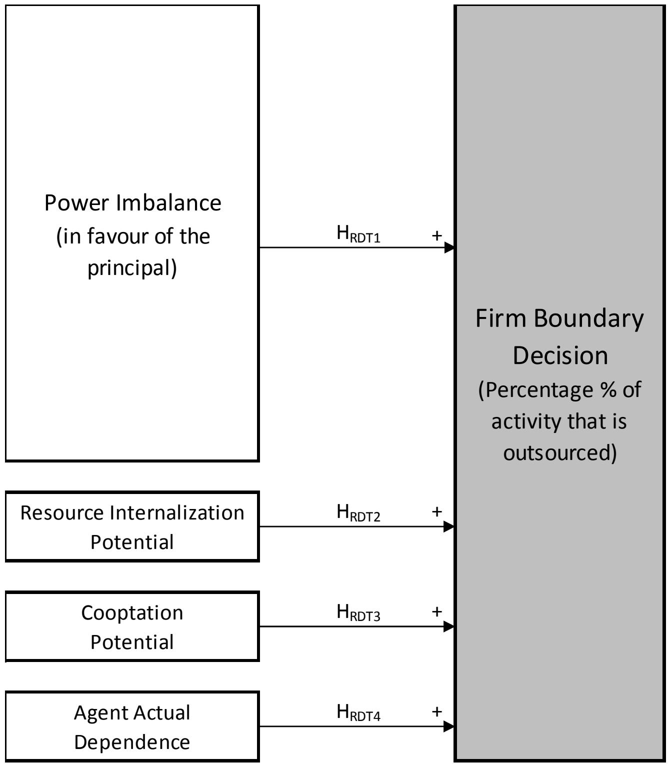


Figure 7-2. Hypotheses from the dependency perspective through resource dependence theory

Boundaries in competence considerations

The study's boundaries with regard to the competence perspective of a firm's sourcing decisions are marked by the following hypotheses derived from the operationalization of the perspective through a particular strand of the resource-based view of the firm:

H_{RBV1}: The higher a focal resource's contribution to higher gains is, the less outsourced the resource is likely to be.

H_{RBV2}: The higher a focal resource's contribution to lower costs is, the less outsourced the resource is likely to be.

H_{RBV3}: The higher a focal resource's potential contribution to higher gains and/or lower costs is, the less outsourced the resource is likely to be.

H_{RBV4}: The higher a focal resource's natural scarcity is, given a non-trivial level of current or potential resource value, the less outsourced the resource is likely to be.

H_{RBV5}: The higher the level of a focal resource's inimitability, given a non-trivial level of current or potential resource value, the less outsourced the resource is likely to be.

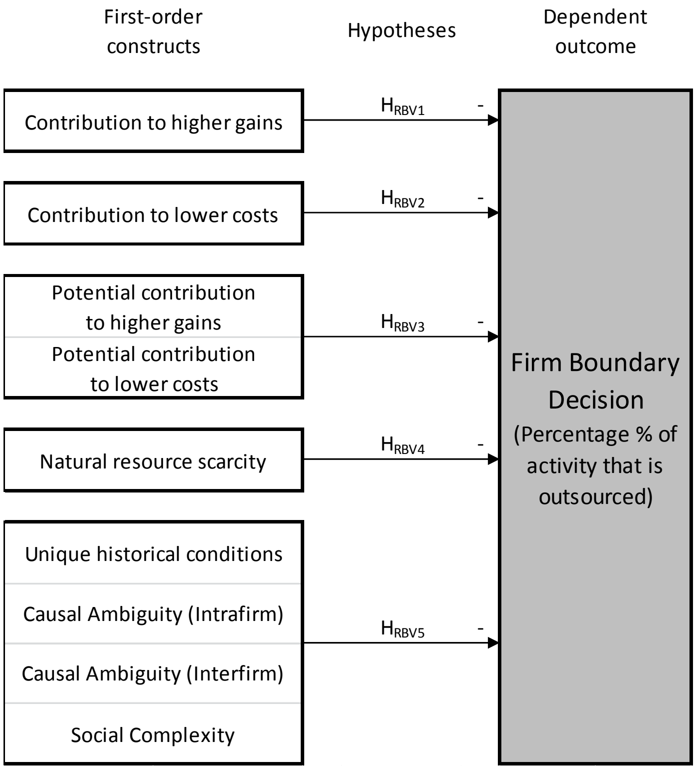


Figure 7-3. Hypotheses from the competence perspective through the resource-based view

Boundaries in identity considerations

The study's boundaries with regard to the identity perspective of a firm's sourcing decisions are marked by the following hypotheses derived from the operationalization of the perspective through organizational identity coherence:

H_{OIC1}: The higher the level of a focal resource's alignment with the organizational identity of a focal firm is, the less outsourced the resource is likely to be.

H_{OIC2}: The higher the level of the institutional forces influence is, the higher the impact to the focal firms' sourcing decisions is likely to be.

H_{OIC3}: The higher the level of the industrial forces influence is, the higher the impact to the focal firms' sourcing decisions is likely to be.

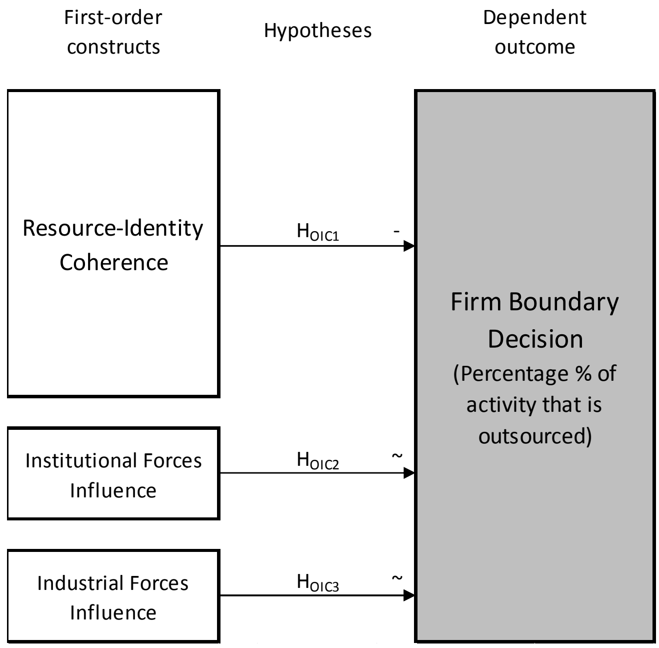


Figure 7-4. Hypotheses from the identity perspective through organizational identity coherence

7.3 Research approach

Having reported on the study's research questions and boundaries, this section delves into the methodological approach adopted in order to answer the aforementioned research inquiries.

7.3.1 A variance-based empirical study

The fundamental items of interest studied in this research are recognized to be: (1) a customer firm's boundary choices (or sourcing decisions) with regard to a number of activities targeted by the offering of transactionally servitized offerings, as well as (2) the factors (or variables) that influence these choices in a particular context. As such, a logico-scientific variance-based research model (Bruner, 1986) is adopted as it is considered to be appropriate for the nature of the research questions asked (Van de Ven, 2007). In electing a variance-based research model, an outcome-driven explanation of the phenomenon is sought. This is principally achieved through the awareness of particular observed outcomes (i.e. sourcing decisions pertaining to the degree that an activity is outsourced or not) in relation to prior causally significant events or characteristics (e.g. activity attributes) (Aldrich, 2001).

Given the study's research approach, a principle dependent variable is elected in the form of the degree of outsourcing exhibited in a particular activity targeted by transactionally servitized offerings. Consequently, the presence of independent variables (identified primarily by theory derived from previous research) acting upon and causing changes to the dependent variable is anticipated.

7.3.2 Methodological assumptions of research approach

Given the election of a variance-based research approach and in accordance to Poole et al. (2000) and Van de Ven (2007) the following basic epistemological assumptions and the resulting limitations that stem from them are recognized:

> 'The world is made up of fixed entities with varying attributes' (Poole et al., 2000). The fixed entities in this case are perceived to be a series of specific transactions or activities needed by the focal firm and targeted by transactionally servitized offerings. These entities, in turn, are held to exhibit variance in their attribute of where (or by whom) they are conducted in relation to the focal firm. In other words they are held to exhibit variance in their sourcing attribute represented by the degree to which they are outsourced or not by the focal firm.
>
> 'Efficient causality is the basis of explanation' (Poole et al., 2000). As such, an efficient cause, in congruence with Mohr (1982), is recognized as 'a force that is conceived as acting on a unit of analysis… to make it what it is in terms of the outcome variable… or change it from what it was'. In the case of this research, such forces are recognized to be the various particular considerations or factors (independent variables) that influence a focal firm's sourcing decisions, and thus, an activity's (fixed entity) degree of outsourcing (dependent variable).
>
> 'The generality of explanations depends on their ability to apply uniformly across a broad range of contexts' (Poole et al., 2000). As such, it is assumed that in studying the selected phenomenon in a given context, the causes are expected to operate in the same way across all cases studied within the context (Abbott, 1990) and that the generative mechanism is expected to act efficaciously across time in a continual manner (Van de Ven, 2007).
>
> 'The temporal sequence in which independent variables influence the dependent variable is immaterial to the outcome' (Poole et al., 2000). As such, it is deemed that the timing in which strategic considerations (factors) that affect the degree of outsourcing of activities are considered, does not influence the outcome. However, it is also recognized that factors operating in grossly different time frames may be accounted for with the use of models that focus on "macro" and "micro" levels of explanation (Van de Ven, 2007). For example, the existence of a firm-wide long-standing policy prescribing the governance mode choice of all transactions within the firm would be deemed to belong at a macro level while the absence of such policies that allow for the individual choice of the governance mode of particular transactions ascribes to a micro level.
>
> 'Explanations should emphasize immediate causation' (Poole et al., 2000). This pertains to the assumption that at each point in time, the independent variables recognized and studied contain all the information needed to estimate their values at the next point in time (Abbott, 1990).
>
> 'Attributes have one and only one causal meaning over the course of time' (Poole et al., 2000). As such, it is held that each factor influencing an activity's degree of outsourcing will retain its meaning within the given context in a continuous manner (Van de Ven, 2007).

7.3.3 The unit of analysis

As mentioned in the previous section, the study's variance-based research model considers the fixed entities to be a series of specific activities needed by the focal firm and targeted by transactionally servitized offerings. At this point, some clarifications are deemed to be in order.

The nomenclature utilized by each principle strategic consideration identified to influence a focal customer firm's sourcing decisions can be observed to vary in accordance to the terminology adopted by each theoretical paradigm elected to operationalize them. For example, the efficiency perspective articulated through transaction cost economics refers to transactions while the dependency, competence and identity perspectives, articulated through their respective theoretical paradigms refer to resources (with the competence perspective further aggregating resources to the term competences). Moreover, in referring to resources, the dependence and competence perspectives may at first glance be held to refer to different, though not contradicting, entities.

What is argued in this sub-section is that while the nomenclature changes, the entities to which the strategic perspectives refer to do not and can be largely be considered to be the same. The variant terminologies are simply held to represent differences in the terms with which the paradigms choose to describe the entities as well as some differences in the aggregation level to which they choose to observe them. The competence perspective for example, articulated through the resource-based view of the firm refers to resources as tangible or intangible assets that a firm owns, controls or has access to. Furthermore, the same perspective holds a competence to be a configuration of resources that enables a firm to accomplish a particular task. At the same time, the transaction cost economics theoretical paradigm holds a transaction to be the transference of the output of a technologically non-separable group of activities to another similarly non-separable group of activities. In conceptually comparing the two perspectives, the study holds that a transaction may be deemed to be a tangible or intangible asset owned, controlled or accessed by a firm. As such, it may be deemed to be a resource. By extension, a configuration of transactions may further be deemed to comprise a competence. Similarly, the looser definitions of the term resource exhibited in the dependency and identity perspectives, respectively, are further held to refer to configurations of basic assets or transactions that enable the firm to complete useful tasks in their line of operation.

Given the foregoing discussion and in the interest of parsimony the study elects to utilize the all-inclusive term of activity in describing the study's fixed entities of interest. As such, an activity is held to represent configurations of assets or transactions (and thus competences). In the study's particular context of servitization, reference is made to a series of activities that are further held to be of use to the focal customer firm and that are additionally targeted by transactionally servitized offerings.

The aforementioned fixed entities of interest in this particular study of the servitization phenomenon, and in accordance to the exposition provided in the empirical context chapter, include a shipping firm's: (1) Engine maintenance planning, (2) tactical (engine) spare part logistics, (3) regular engine maintenance, (4) engine problem troubleshooting, (5) extraordinary (engine) spare part logistics, and (6) extraordinary engine repairs.

7.4 Methods of inquiry and research design

7.4.1 A probabilistic view of causality

In adopting a variance-based approach, the study specifies a series of expected relationships between the dependent outcome and a series of variable conditions (i.e. the various perspectives' independent variables). In exploring these relationships, the study is not interested in showing that the independent variables are in some form necessary and sufficient conditions for the occurrence of a particular outcome (nor is it believed that such a demonstration is tenable). As such, an essentialist view of causation is rejected and a probabilistic perspective is adopted (Van de Ven, 2007). Therefore, the study is interested in exploring the effect that the proposed causes have over the outcome of interest by manipulating the independent variables (through repeated measurement) and observing the resulting outcomes in the study's dependent variable.

Given the foregoing perspective with regard to causality, it is supposed that cause and effect relationships between variables may be inferred through the following three criteria (Cook and Cambell, 1979):

- Covariation or correlation between presumed causes and effects
- Temporal precedence of causes occurring before the effects
- Absence of spurious factors that may confound the cause-effect relation

With regard to the issue of covariation, it is held that in order to posit that an independent variable is a cause of dependent variable, statistical association is needed. Thus, if no statistical association is found, it could be posited that the variable has no effect on the dependent outcome. At this point, though, a caveat should be stated that in adopting a critical realist philosophical view, the absence of statistical association is by no means considered as 'hard' evidence that the proposed relationship does not exist. It may merely lay dormant (or non-actualized) in the particular empirical context. The same caveat holds in the event of 'weak' yet statistically significant associations. As Singleton and Straits (2005), referenced in Van de Ven (2007), note:

> "In the social sciences, causal relationships often are implied from comparatively 'weak' associations. One reason for this is that many measurements in the social sciences are relatively imprecise. The primary reason, though, is that in explaining human action, multiple causes may independently or jointly produce the same or similar effects. A weak association may mean that only one of several causes has been identified, or it may mean that a causal relationship exists, but not under the conditions or for the segment of the population in which the weak association was observed." (Singleton and Straits, 2005: 58)

With regard to the issue of temporal precedence or otherwise the direction of influence (Van de Ven, 2007), as evidenced also in the formulation of the study's hypotheses, it is held that the causes precede their effects. In other words, the various efficiency, dependence, competence and identity considerations taken into account are thought to precede the decision to insource or outsource the activities of interest. In essence, what is posited through this assertion is that when one inquires the prevailing sourcing circumstances of a particular activity in a particular focal firm in the present, it is held that the sourcing position held (may it be to insource or outsource) is the on-going product or decision deriving from the deliberate managerial consideration of the proposed causes. In this particular research, the direction of influence is empirically examined through repeated observations of the variables in question.

Finally, with regard to the issue of spurious factors confounding the cause-effect relationship, it is held that for a causal relationship to be inferred from a statistically significant correlation or regression there should be valid reasons to believe that no extraneous confounding factors affect the relationship in a way that the association is found by chance (Van de Ven, 2007). To minimize the potential presence of spurious factors in this particular study's empirical setting, two approaches are simultaneously in effect. The first has to do with the election of the empirical setting itself, while the second revolves around the statistical control of a number of factors prior to the examination of the study's hypothesized relationships. In both cases, the study strives to formulate a ceteris paribus, or otherwise an 'all else being equal' context so that the proposed relationships may productively be explored. In other words, the study attempts to compare or examine repeated observations of the outcome of interest while controlling for differences not included in the study's varying conditional hypotheses.

As mentioned also in the chapter describing the election of the study's empirical setting, the choice of the particular empirical context was informed by the aforementioned need to control the presence of spurious factors that could potentially confound the supposed relationships. As such, the empirical context choice strived to identify a setting were the focal firms (in this case marine shipping firms that are potential customers of transactionally servitized offerings) commonly shared as many environmental and contextual characteristics as possible. That is to say that the study strived to observe the dependent outcome (activity sourcing decision) within the bounds of similar entities. By observing the outcome in similar entities that are affected by the same extraneous environmental and contextual factors it is asserted that such factors are effectively controlled for. In this study's case for example, the deep-sea marine shipping industry was elected, among other reasons reported in the empirical context chapter, due to the fact that all of the firms in the setting operate in the same globalised arena of sea-trade and are all subject to the same prevailing economic conditions, industrial regulations and overall industry outlook.

The second means with which the influence of potentially spurious factors is attempted to be minimized is through the statistical control of a number of potentially confounding factors prior to the exploration of the study's main hypothesized relationships. This is achieved by identifying, measuring and effectively testing the influence of such factors prior to the statistical testing of the study's hypotheses. Nevertheless, as pointed out also by Van de Ven (2007):

> "… it is not possible to consider all factors. One can only attempt to consider and evaluate the effects of the most plausible factors based on knowledge gained from prior research and the particular context and setting in which the research is conducted." (Van de Ven, 2007 p.170)

The study's particular extraneous factors that are controlled prior to the research's hypothesized causal relationships include a shipping firm's (1) size, (2) age and (3) average ship age.

7.4.2 Research design: A quasi-experimental cross-sectional survey

The primary method of inquiry and consequently the research design utilized in this study is that of a quasi-experimental cross-sectional survey (Cambell and Stanely, 1963; Glock, 1967; Van de Ven, 2007). The study's elected research design and its relation to alternative variance-based research designs is portrayed in Figure 7-5.

In defining the method of inquiry as a cross-sectional survey it is conveyed that static rather than dynamic causal models are explored at one particular point in time. As such, a longitudinal approach is not adopted within the bounds of this research. Furthermore, in specifying the survey as a quasi-experimental approach it is recognized that the study is not in a position to randomly assign the units of analysis to specific conditions and deliberately manipulate the treatment of proposed causes. In contrast, the units of analysis are thought to be brought to specific conditions through naturally occurring events the effects of which the study is striving to study (Van de Ven, 2007).

As such, the outcomes of interest, in this study the sourcing decisions related to the focal activities targeted by transactionally servitized offerings, are conceived to occur naturally under the influence of specific conditions that in this study include the managerial deliberation of various strategic considerations. Given this premise, the study treats all of the observed cases in an identical way by measuring all the hypothesized independent variables per each unit of analysis through survey methods and subsequently explores the supposed causal relationships by means of statistical analysis.

In utilizing a cross-sectional survey design, and as argued by Cook and Campbell (1979), the study supports the notion that this method is the only one that allows the testing of statistical significance, and thus, the establishment of covariation or correlation between the research's presumed causes and effects of the phenomenon. Furthermore, a survey-based mode of inquiry is expected to enable, even restrictedly, the generalization of the study's findings in a broader context (Jick, 1979).

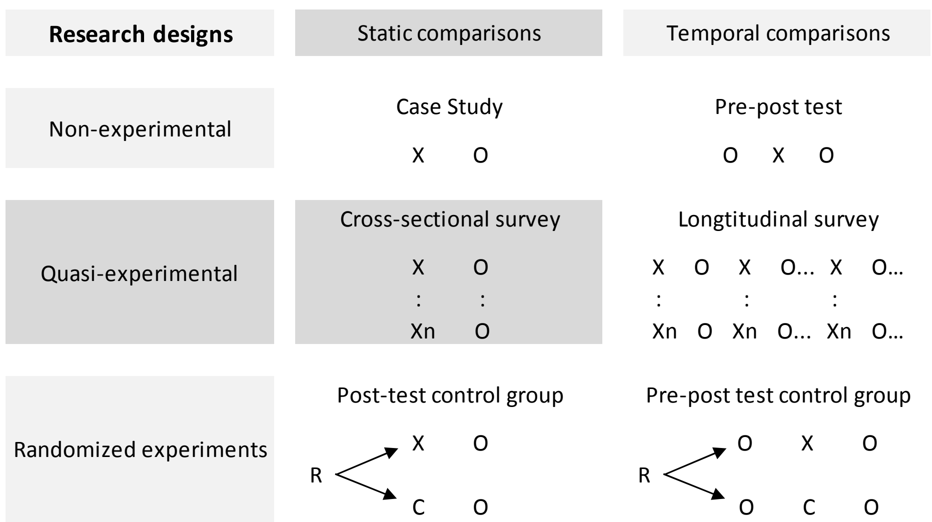


Figure 7-5. Elected research design in relation to alternative variance research designs (adapted from Van de Ven, 2007 p.173)

7.5 Population of interest, sampling frame and survey sample

Having delineated the study's research questions, boundaries, approach and design, focus is now put on the relatively more practical issue of the study's sampling design. In accordance with Singleton and Straits (2005), a three-stage process is employed in order to describe the study's sampling design. The three stages include: (1) the identification of the target population, (2) the construction of an appropriate sampling frame, and finally (3) the application of a probability or non-probability based sampling strategy.

7.5.1 Target population

Beginning with the issue of identifying the target population, or otherwise the population of interest, reference is made to some of the requirements posed previously during the election of an appropriate empirical context. As such, given the election of the deep-sea marine shipping industry as the study's contextual locus, and with the units of analysis being a set of six ship main engine maintenance activities, the target population is briefly given to consist of marine shipping firms operating deep-sea-fearing merchant marine vessels that are actively engaged in the international transportation of dry and wet cargo. At this point it should be stated that given the globalized nature of the target population, no particular geographic restrictions apply.

By stipulating that the marine shipping firms in question are engaged in the deep-sea international transportation of dry and wet cargo, it is implied that shipping firms engaged in localized (national) freight transportation or transportation through inland waterways, are excluded. To provide some reference with regard to this stipulation, cargo transported through inland waterways accounted an approximately 27.2% share of the world total revenue generated through the water-based transportation of cargo in 2010 (Marketline, 2012). Furthermore, and by the same token, firms engaged in the transportation of passengers in local routes or otherwise are similarly excluded. As such, cruise line operating firms fall well outside the bounds of this study's empirical context.

To further characterise the target population, it includes firms owning or directly controlling as well as operating cargo carrying sea-fearing vessels able for ocean, or otherwise deep-sea, voyages. The condition with regard to the firms operating the ships they own, or somehow control (e.g. through long-term bareboat chartering contracts), is devised in order to exclude ship-holding companies which while listing ships in their assets, they usually do so either for rather complicated corporate tax issues or for the reason of simply being asset-holding and asset-leasing firms far removed from the day-to-day reality of shipping operations.

Finally, to reference the types of ships usually involved in the deep-sea transportation of cargo and which are expected to be operated by the firms of the target population, they can broadly be characterized as merchant marine vessels upwards of 1,000 Dead Weight Tonnage (DWT[1]) that can further be classified in two major categories: dry cargo carriers and wet cargo carriers. Dry cargo carriers include: Bulk Carriers (BCs), Ore Carriers (OCs), Very Large Ore Carriers (VLOCs), Container Ships (CNs), general Cargo Ships (CSHs), Cargo Container ships (CCNs), general Vehicle Carriers (VCs), Roll On/Roll Off vehicle carriers (RORO) and Wood Products Carriers (WPCs).

[1] DWT: Dead Weight Tonnage is the weight a ship can carry when loaded to its marks with cargo, fuel, fresh water, stores and crew.

Finally, a more specialized type of dry cargo carriers, involved in the transportation of perishable goods, are Reefer Ships (REEFs). Wet cargo carriers include: Tanker Ships (TSHs), Very Large Crude Carriers (VLCCs), Ultra Large Crude Carriers (ULCCs), Chemical Tankers (CTs), Product Tankers (PTs), Product/Chemical Tankers (PCTs), Liquefied Petroleum Gas carriers (LPGs), Liquefied Natural Gas carriers (LNGs) and Very Large Gas Carriers (VLGCs).

All of the aforementioned sea-fearing vessels, with few unremarkable exceptions, utilize the functionality of a two-stroke low speed marine diesel engine as the primary means of propulsion. As such, shipping firms controlling and operating any number of examples of these ship-types are considered as valid and suitable cases for the observation of the phenomenon and outcome of interest. Finally, to give some sense of proportion, according to the International Maritime Organization, the world's cargo carrying fleet in 2011 consisted of a total of 55,138 ships with an average age of 19 years and a combined DWT of 1,483,121,493 tonnes (IMO, 2012).

7.5.2 Sampling frame

Having established the study's population of interest, focus is put on the second-stage of the sampling design that includes the construction of an appropriate sampling frame. In congruence with Singleton and Straits (2005:116), the sampling frame is intended to identify the set of all cases from which the sample is actually selected. According to Van de Ven (2007) the construction of the sampling frame may be achieved:

> "… by either listing all the cases in the [target] population or by developing a rule that defines membership in the population. Oftentimes it is not possible to identify all members of a target population. A census listing of all members of a target population may not exist. Instead, researchers often rely on a rule stipulating criteria for inclusion and exclusion…" (Van de Ven, 2007 p.182)

In recognizing that an exhaustive listing of all members of the target population (i.e. all of the world's marine shipping firms operating merchant marine ships upwards of 1,000 DWT) is not practically feasible, the study resorts to an alternative means of constructing an appropriate sampling frame. The alternative approach in question revolves around the combined utilization of industry international association membership listings as surrogates in the place of a theoretical exhaustive listing of all members of the target population. In other words, the study sought to identify internationally-minded marine shipping industry associations whose membership listings could act as the study's sampling frame.

Two such organizations are identified in the guise of INTERCARGO and INTERTANKO. INTERCARGO is the International Association of Dry Cargo Shipowners, while INTERTANKO is the International Association of Independent Tanker Owners. According to the organization, INTERCARGO member firms operate predominantly on the international dry bulk trades, involving the transportation of cargo such as coal, grain, iron ore and other bulk commodities (INTERCARGO, 2012). On the other hand, the membership of INTERTANKO consists primarily of independent tanker owners and operators of oil and chemical tankers (INTERTANKO, 2012). With the term independent INTERTANKO membership is specified not to include companies directly affiliated with any of the major oil-producing firms or nationalized firms that are state controlled. Both associations explicitly attest to their role as industry spokespersons with INTERTANKO stating that:

“The strong support that INTERTANKO enjoys allows it to speak authoritatively and proactively on behalf of tanker operators at international, regional and local level[s].” (INTERTANKO, 2012)

Apart from the association’s self-reported testimony, the advantageous standing of utilizing these two organizations’ membership lists to compile the study’s sampling frame is further supported by their admittedly impressive statistics. At the time of the study’s performance (Summer 2011), the combined and cross-referenced membership list of the two associations included 241 unique business entity firms hailing from a total of 38 countries (with 15 countries accounting for 87% of the membership total). Table 7-1 compiled for the purposes of this research presents a series of key statistics for the combined membership of INTERCARGO and INTERTANKO.

Table 7-1. Membership statistics of INTERCARGO and INTERTANKO combined (as of August 2011; ranking by total DWT)

Country of origin	Firms	Ships	Dry cargo ships	Container ships	Wet cargo ships	Reefer ships	Other ships	Combined ship DWT	Average ship age
Greece	84	1,122	365	57	666	29	5	102,899,575	10.4
Japan	9	1,439	683	316	400	40	0	88,253,711	8.4
Denmark	8	935	284	320	331	0	0	52,413,836	8.9
Norway	19	482	71	10	401	0	0	39,914,900	10.3
Spain	2	208	50	113	45	0	0	18,824,359	9.4
Singapore	5	240	107	0	133	0	0	18,380,460	7.9
Hong Kong SAR	6	240	195	10	35	0	0	17,819,282	9.8
Canada	2	113	0	0	113	0	0	13,041,296	8.5
Italy	17	205	27	0	178	0	0	12,795,849	6.6
USA	7	144	104	0	40	0	0	12,111,775	13.2
Cyprus	4	220	21	43	153	0	3	11,880,263	8.9
P.R. China	2	108	104	0	4	0	0	10,756,874	16.4
Iran	1	39	0	0	39	0	0	9,604,000	8.9
Germany	15	287	44	68	175	0	0	8,963,955	8.0
United Kingdom	7	78	53	0	25	0	0	8,297,288	9.6
United Arab Emir.	4	71	8	0	63	0	0	8,173,466	6.6
Turkey	10	114	43	1	70	0	0	8,068,522	7.9
Russia	2	72	2	0	70	0	0	6,589,837	6.3
India	6	85	36	0	49	0	0	6,082,821	17.7
Malaysia	1	60	1	19	40	0	0	4,822,561	11.8
Sweden	6	90	0	0	84	0	6	4,746,073	7.7
Belgium	3	63	29	0	34	0	0	4,335,276	7.3
Netherlands	3	110	3	0	107	0	0	3,550,890	9.1
France	2	63	20	0	10	0	33	2,200,720	9.0
Libya	1	24	0	0	24	0	0	2,118,610	8.1
Croatia	1	20	9	0	11	0	0	1,564,956	8.5
South Korea	2	29	8	0	21	0	0	1,220,607	11.1
Switzerland	2	20	0	0	20	0	0	962,879	6.6
Latvia	1	20	0	0	20	0	0	939,681	6.3
Finland	1	8	0	0	8	0	0	819,984	11.9
Monaco	1	12	0	0	12	0	0	744,657	6.5
Chile	1	21	0	0	21	0	0	636,164	10.5
Bermuda	1	6	0	0	6	0	0	479,877	19.0
Romania	1	10	1	0	9	0	0	449,689	9.0
Qatar	1	7	0	0	7	0	0	426,271	7.4
Argentina	1	9	0	0	9	0	0	388,061	6.1
Mexico	1	9	0	0	9	0	0	351,222	10.1
South Africa	1	11	0	0	11	0	0	275,500	3.7
Total	**241**	**6,794**	**2,268**	**957**	**3,453**	**69**	**47**	**485,905,747**	**9.3**

Given the IMO statistics for 2011 and the combined INTERCARGO and INTERTANKO membership statistics, at the time of the study, the elected sampling frame accounted for 12.32% of the world fleet in the number of vessels but more impressively it made up 32.76% of the world fleet’s total carrying capacity in DWT. Tables A.1 and A.2 referenced in the study’s Appendix report on the membership of the two associations at the time of the study.

While the constructed sampling frame may technically be referred to as one of convenience, it is put forth that given its international diversity and world fleet representation rates (border lining on a third of the world commercial fleet's carrying capacity) it may be considered as an acceptable compromise between practical considerations and validity requirements.

7.5.3 Sampling strategy and minimum requirements

Having constructed the study's sampling frame, focus is put on the sampling strategy adopted in the study's collection of empirical evidence. Given the relatively manageable size of the study's sampling frame, no particular probability-based sampling procedure is utilized. Instead the study proceeds to the inquiry of all members of the sampling frame. Notable exceptions to this exhaustive sampling procedure include the exclusion of firms from Libya and Iran due to extraordinary circumstances present at the time of the study's data collection process (e.g. the Libyan civil war of 2011).

At this point, it should be underlined that while the target population of the study's empirical efforts is defined as a set of marine shipping firms, the actual entities of interest are still each firm's sourcing treatments of six key maintenance activities identified earlier in the thesis's empirical context chapter and reiterated in this chapter's discussion of the unit of analysis. As such, it is understood that the sampling frame containing 241 marine shipping firms can theoretically yield a total of 241 x 6 = 1446 observations of the phenomenon of interest (i.e. the degree of insourcing or outsourcing of a focal maintenance activity targeted by transactionally servitized offerings). Therefore, it should be clear that each corporate response is given to provide six empirical instances or outcomes deemed as empirical cases of the dependent variable.

Given the study's orientation towards statistical significance, minimum requirements for the study's sample's size are taken into consideration. While the study's statistical procedures are addressed in the data analysis and empirical results chapter, some key sample requirement issues are reiterated here for reference. The study's principle method of data analysis and statistical inference is based on multiple or otherwise multivariate regression analysis. As with any statistical procedure, sample size is dependent on the desired power, alpha level, number of predictors (i.e. independent variables) and expected effect sizes (Tabachnick and Fidell, 2007:123).

To accommodate the calculation of minimum sample requirements the study assumes a medium-sized relationship between the independent and dependent variables, an alpha level of a = .05 and β = .20. The rules of thumb or basic formulae designated for the aforementioned assumptions with regard to the testing of (1) multiple correlation and (2) individual independent variables are (1) $N \geq 50 + 8m$ and (2) $N \geq 104 + m$. Given that the study's number of individual predictor variables entered in a multiple regression analysis is not expected to be any higher than 21, and utilizing the first sample size formula of testing multiple correlation, the minimum number of observations needed by the study is 218 unique sourcing decisions of maintenance activities. Finally, given that each shipping firm response is expected to yield 6 observations the minimum number of firms required to participate in the study's survey total a number of 37 firms (218 / 6 ≈ 36.32). Corollary to this calculation is the acknowledgement that the study's surveying efforts ought to yield at minimum a 15.4% response rate to meet the analysis sample size requirements. Retroactively reporting on the survey's final response rate and sample, the study achieved a response rate of 24.8% with 60 firms completing the whole of the survey's questionnaire (the study's incomplete survey response rate was 29%). As such the study has at its disposal a total of 360 unique observations of the outcome of interest (60 firms x 6 activities = 360 observations).

7.5.4 Survey informant requirements

A stipulation put forth by the study's research design is that each shipping firm is allowed to provide only one response to the survey questionnaire. As such, at minimum one informant per company is needed to complete the questionnaire in question. The study's informants, or otherwise the persons deemed as more appropriate to answer the cross-sectional survey's questions are identified to include senior technical and executive shipping firm managers that are familiar with the firm's fleet maintenance processes. In the elected empirical context these stipulations identify the positions of Chief Executive Officer (CEO), Chief Technical Officer (CTO), Chief Operations Officer (COO), Fleet Manager (FM), Technical Manager (TM) and Chief Superintendent Engineer (CSE) as management officers suitable to fill the role of informants for the study.

Seniority, or otherwise the targeting of top-management level executives for the study's informant requirements is posed due to the largely strategic nature of the issues and considerations covered in the study. As such, it is posited that senior managers are in a better position to answer questions surrounding such issues due to increased industry experience, and a more in-depth knowledge of the inner workings of their respective shipping firm. Proximity to technical affairs is a further requirement posed due to the technical nature of the study's entities of interest (main engine maintenance activities).

Finally, it should be further noted that medium-level technical officers are not favoured as informants due to potential issues of self-interest bias. That is to say that, while senior executive and top technical officers' job security is largely assured even if a firm decides to outsource all of its maintenance activities, placement for mid-level technical officers and engineers is not. As such, it would be reasonable to assume that, at least in part, mid-level managers would be biased towards personally favourable outcomes and or resource characteristics.

Chapter 8

Measurement models and data collection

8.1 Introduction

Having articulated the study's methodological foundation and in recognizing the research design as that of a quasi-experimental cross-sectional survey, this chapter focuses on the development of the study's measurement models and data collection process. Specifically, the chapter articulates the development and administration of the survey instrument through the operationalization of the study's conceptual constructs into a series of scales appropriate for the study's empirical context. Particular issues of survey instrument design and administration are further reported.

8.2 The C-OAR-SE method for scale development

Having articulated the elements of the four strategic perspectives under study in a series of theoretical constructs clearly defined through past research (e.g. Value Assessment Ability, Cooptation Potential, etc.), focus is now put on the measurement of the properties of said constructs in the study's elected empirical context. Measurement can be defined as the process of assigning numbers or labels to variables of units of interest in order to numerically represent their conceptual properties (Singleton and Stratis, 2005:76).

According to Van de Ven (2007), measurement basically represents a problem of conceptualization. As such, it is thought of as a process in which the research attempts to move from the abstract to the concrete by recasting theoretical constructs into observable variables and subsequently devising replicable procedures and valid indicators (i.e. indicators capturing the constructs' intended meaning) in order to measure said variables (ibid.:184).

In tackling the issue of operationalizing and enumerating the various theoretical constructs included in this research (with some notable exceptions), the study principally draws upon the methodological rationale of Rossiter's (2002) C-OAR-SE method for scale development. Devised as an acronym that briefly reports on the method's stages, C-OAR-SE stands for Construct definition, Object classification, Attribute classification, Rater identification, Scale formation and Enumeration. As reported by Rossiter (2002), the method draws upon the previous work of McGuire (1989) on the conceptualization of constructs as well as the work of Blalock (1964), Fornell and Bookstein (1982), Cohen et al. (1990), Bollen and Lennox (1991), Law and Wong (1999) and Edwards and Bagozzi (2000) on the classification of attributes. In addition to the method's background, this study's utilization of the method for scale development is further informed by the continuing academic discourse that surrounds this relatively novel approach (e.g. Boorsboom et al., 2004; Diamantopoulos, 2005; Rossiter, 2005; Bergkvist and Rossiter, 2007; Diamantopoulos et al., 2008; Bergkvist and Rossiter, 2009; Rossiter, 2011).

The C-OAR-SE method, as underlined by Rossiter (2002) is grounded in rationalism rather than empiricism. As such, it thought to be in congruence with this particular study's philosophical foundation in critical realism. According to the method's rationale, each construct of interest may be defined in terms of a focal object (henceforth referred to as 'object', regardless of whether that object is of a physical or perceptual nature), a dimension of judgment (here referred to as 'attribute') (McGuire, 1989) and the judges or raters (here referred to as 'rater entities') that confer meaning to the construct (Rossiter, 2002).

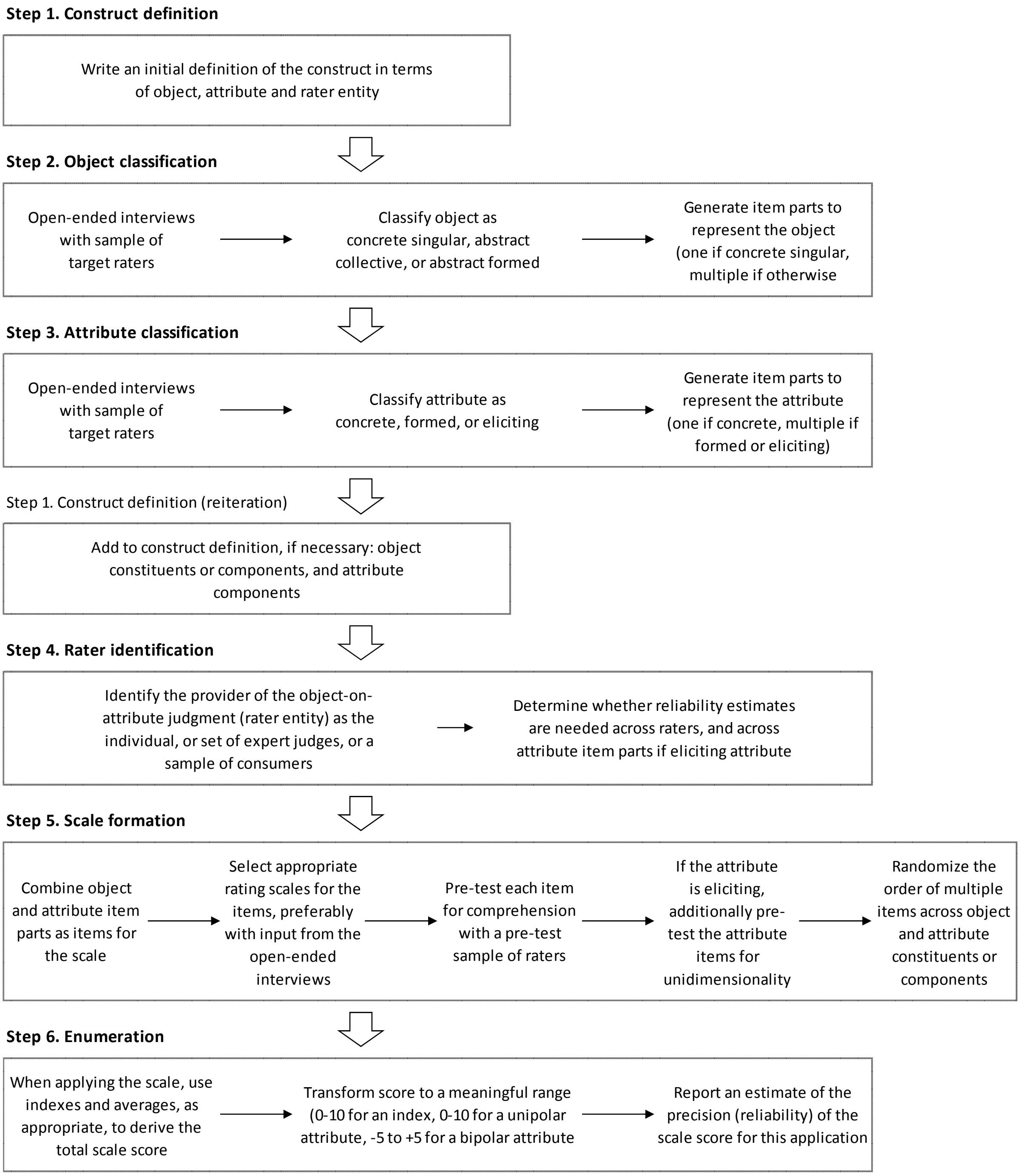


Figure 8-1. Steps in the C-OAR-SE scale development method (adapted from Rossiter, 2002)

Under this methodological approach, six steps are advised in the development of an appropriate measure of a construct. These are summarily portrayed in Figure 8-1 and subsequently expanded upon in the following sub-sections.

8.2.1 Object classification

The C-OAR-SE method allows the classification of a construct's object as being either concrete singular, abstract collective or abstract formed.

Concrete singular objects are held to represent cases where all raters are held to be well aware of what the object is and that, for them, there is only one object (Rossiter, 2002). In this study's context, examples of concrete singular objects are thought to be a particular shipping firm perceived as an autonomous business entity, a ship's main propulsion engine or the notion of a particular maintenance activity with discrete end-results.

Abstract collective objects, in turn are thought to be objects that while heterogeneous in the eyes of the raters (i.e. conceived to consist of separate constituents) are nonetheless held to form a set at a higher categorical level that is consisted by a collection of otherwise concrete objects (ibid.). An example of such an abstract collective object in the study's particular empirical setting is the notion of the marine shipping industry as a business sector consisting of competing firms aimed at the generation of revenues through the seaborne transportation of cargo.

Abstract formed objects, finally, are thought to be objects conceived to consist of different, equally valid, components and whose interpretation by raters is bound to differ. Rossiter (2002) offers the notion of capitalism as such an abstract formed object. In this study's empirical context the notions of competition or competitive advantage might qualify as examples of abstract formed objects.

With the exclusion of relatively simple and well understood objects, the C-OAR-SE method encourages the classification of objects of interest in a survey setting to be conducted in unison with open-ended interviews with a sample of the survey's target raters. In the cases of abstract collective or formed objects, these interviews are further held to ratify the main constituents of abstract collective objects or the main components of abstract formed objects (ibid.).

8.2.2 Attribute classification

The third step of the C-OAR-SE method is targeted at the classification of an object's attribute under judgment. An object's attribute under judgment is considered to be the dimension upon which the object is being judged by the raters. The method allows the classification of an object's attribute as being either concrete singular, abstract formed or abstract eliciting. In the interest of parsimony the terms singular and abstract are considered redundant so that attributes may simply be referred to be concrete, formed or eliciting (Rossiter, 2002).

Concrete attributes, in a similar fashion to concrete singular objects, are conceived to be attributes whose meaning and comprehension is accepted by raters to represent one, or holistically one characteristic of the object (ibid.). At this point, Diamantopoulos's (2005) contention with regard to the confounding treatment of denotations and connotations of objects or attributes in C-OAR-SE is acknowledged. Thus, it is recognized that, at least conceptually, there is no such thing as a singularly concrete object or attribute, but that there are cases where uniquely suitable observable items (one per each object or attribute) may thoroughly operationalize the unobservable latent variable through which the object or attribute is represented. While also acknowledging Diamantopoulos's (2005) insinuation that practical issues (e.g. minimizing the valuable respondent time of high-level executives) may lie behind the concrete singular concept, as pointed out by Rossiter (2002) and Drolet and Morrison (2001), it is further acknowledged that:

> "…the practice of attempting to measure a concrete attribute by inserting multiple items to 'capture' it (and to satisfy journal requirements for multi-item measures) not only leads to wasteful redundancy, but the additional items usually 'drift off' the original

conceptually defined attribute and start picking up the substance of other attributes." (Rossiter, 2002:313)

Formed attributes are considered to be multi-componential items of an object of interest whose components collectively form and give substance and meaning to the attribute (Rossiter, 2002). Otherwise referred to as formative attributes they are considered a part of the formative measurement model approach (e.g. Blalock, 1964; Bollen and Lennox, 1991; Diamantopoulos and Winklhofer, 2001; Diamantopoulos et al., 2008). The distinguishing characteristic of such attributes is that their components are the elements that create the attribute. In other words, the components are not seen as manifestations of the attribute but forming characteristics. As such, formed attributes do not fall within the domain sampling approach. That is to say that, items are not interchangeable and the inclusion of further items or the exclusion of existing ones would lead to the misspecification of the attribute.

In the case were the components are themselves identified as formed attributes (making the original attribute a second-order abstract formed attribute), these components are themselves thought to be attributes (though subsidiary to the original focal attribute). In any case, the C-OAR-SE method necessitates that first-order components of attributes need to be of a concrete nature (see caveat in the discussion of concrete attributes). As such, in articulating the measurement model of formed attributes, the goal is set to be the development (through expert target rater consensus) of (at least) one appropriate item for each first-order component (Rossiter, 2002). Due to the constructed nature of formed attributes, factor analysis of their items to establish some sort of unidimensionality or high alpha levels is considered to be an erroneous practice.

Eliciting attributes finally, are thought to be abstract notions that represent an 'internal' trait or perceptual disposition (state). In the case of elicit attributes, whose interpretation is thought to vary in the eyes of raters, the constituting items are perceived as results, or otherwise as 'indicative manifestations' of the trait or disposition (Rossiter, 2002). Otherwise referred to as reflective attributes, elicit attributes adhere to the reflective measurement model approach, and thus, fall within the domain sampling approach (Nunnally, 1978; Churchill, 1979).

As items of eliciting attributes are seen as 'proximal consequences' of the internal state or disposition, it is logical to assume that there are many such consequences through which the trait may be 'captured'. These consequences, and in turn their relevantly describing items, are thought to be interchangeable and a reasonable sample of them would be sufficient to effectively capture the underlying construct. As such, with regard to elicit attributes, the C-OAR-SE method adheres to domain sampling theory propositions in that it is necessary for such attributes to exhibit unidimensionality (as one particular trait is causing the items, and hence their responses to appear) demonstrated by the inter-correlation of their items within a second-order factor (Rossiter, 2002).

8.2.3 Rater identification and reliability issues

The fourth step in the C-OAR-SE method is the identification of the rater entity utilized for the measurement of each construct in question. The method acknowledges three types of rater entities: the individual, the group and experts (Rossiter, 2002). At this point, it should be emphasized that the study is in accordance with Diamantopoulos (2005), in that the identification of the rater entity, though relevant and useful, is not considered as an integral part of a construct's definition (contra Rossiter, 2002). More importantly through, the identification of the rater entity, in C-OAR-SE, is held to have fundamental implications with regard to the estimation of scale-score reliability. While reliability in the form of internal consistency (i.e. Cronbach's alpha) is acknowledged in the case of scales dealing with eliciting (i.e. reflective) attribute scales, the C-OAR-SE method holds reliability to refer to estimates of the precision of a scale's scores (Rossiter, 2002). More on the ways with which reliability estimates are derived in the C-OAR-SE method are reported in each rater entities case.

The individual is considered to be the rater entity in all individual difference constructs that involve self-reports (Rossiter, 2002). In the case of the individual, the object of inquiry is the 'self' when a trait is attempted to be captured or the 'external stimulus' in the case of a state being elicited. The attribute in turn is considered to be the 'individual-difference disposition' of interest (ibid.). Reliability of self-reporting individual raters is a non-issue for C-OAR-SE, arguing that the reliability of highly content-valid items (ratified by expert judgement) depends solely upon the truthfulness of the rater's responses.

The group is considered as a set of individual persons bearing some relevance to the object of interest. As such, the group may include managers, salespersons, general employees and the like. In the case of the group rater entity, the object of inquiry is usually something other than the self, that may include a company, a product, or in this study's case a maintenance activity. Reliability of scale-score measurement, when the group rater entity is involved, is dependent on Confidence Intervals (CI) calculated through the size of the group and the standard deviations of observed ratings.

At the most basic level, according to the C-OAR-SE procedure, the reliability levels of a scale applied in a given setting, assuming random sampling without replacement from an infinite normally distributed population, may be calculated a posteriori through the standard error (or margin of error) formula of a sample population's mean statistic (i.e. mean estimate):

$$\mu \pm z\left(\frac{\sigma}{\sqrt{n}}\right)$$

where: *μ is the population mean estimate*
z is the confidence level z-value for normal distributions
σ is the standard deviation of the scale's scores
n is the sample size

Given a confidence interval (CI) of 95% (as suggested by Rossiter, 2002) and by looking up the relevant z-value normal distribution statistics tables, z corresponds with 1.96 standard errors. As such, substituting for the z value equation:

$$\mu \pm 1.96\left(\frac{\sigma}{\sqrt{n}}\right)$$

Finally, if the sample is drawn from a finite population (whose size is denoted by N) or more specifically if the sample exceeds 5% of the population total, then a Finite Population Correction (FPC) factor is further multiplied with the standard error of the mean. Thus, the equation becomes:

$$\mu \pm 1.96\left(\frac{\sigma}{\sqrt{n}}\right)\sqrt{\frac{(N-n)}{(N-1)}}$$

Subsequently, to derive reliability estimates on a percentile form, C-OAR-SE prompts the subtraction of the maximum error (i.e. the sum of the + and – errors) from 1, then to be multiplied by 100.

Experts, finally are advised when the ratings or otherwise the collection of measurements necessitates specially trained or otherwise qualified rater entities. In the case of expert judges the raters are thought to be conducting a process akin to content analysis (ibid.). As such, the reliability of the ratings is dependent upon inter-judge (or otherwise inter-coder) agreement and may be calculated through Rust and Cooil's (1994) Proportional Reduction in Loss (PRL) formula (see also the assumptions and methodology of content analysis presented in the theoretical foundation of servitization chapter).

8.2.4 Scale formation and enumeration

Scale formation is the process of combining the object item parts with their corresponding attribute item parts. This process is held to form the 'stem' or question part of the scales on which the response alternatives remain to be added. During this phase of measurement model development the content of the scale items (or otherwise the wording) is devised. Though the wording of the scale items cannot be entirely distinguished from the answer formats that accompany them (i.e. the response alternatives) it would be useful to now report on some good practices that were adhered to when developing the various scales' items. These include the avoidance of:

- Complex wording or structure
  (i.e. complicated vocabulary/terminology, syntactical expressions, idioms)
- Vague or overly generalizing phraseology
- Phraseology that could prompt the presence of a 'right' answer
  (to minimize the risk of social desirability bias)
- Double-barrelled items where more than one issues are inquired

At this point, it should be noted that wherever possible, the study made use or drew inspiration from the content of measures utilized in past research. Appropriate references for such occurrences are offered in each strategic consideration's measurement model development section.

Addressing the issue of developing a scale's alternative response options, or otherwise answer formats or 'leaves', and correctly associating them with the stem (question) part of the scale, the study adheres to Rossiter's (2002) suggestion of avoiding question wordings were intensity is built into the stem (e.g. "Our company *never* has contact with academia). As a result, answer formats of the type "strongly disagree – strongly agree" are equally avoided for a number of issues regarding conceptual interpretation (Rossiter, 2005). Instead, intensity is purposefully built into the response alternatives.

As such, the scales developed for use in this study are worded with intensity-free stems and minimum to maximum intensity leaves. While the use of verbal labels as anchoring descriptions of minimum and maximum intensity have been inferred to more validly represent discriminable states of mind than numerical ones (Windschitl and Wells, 1996), Rossiter (2002) posits the difference to be menial. This particular study adopts both verbal as well as numerical anchoring points in order to comprehensively prompt the existence of a psychological zero category. In particular, the numerical format utilized in signalling the anchoring points of the various response categories ranges from 0 to 6 (a 7-point numerical score scale).

Furthermore, the study recognizes three basic response dimensions that can possibly be measured in each attribute's case as per Rossiter (2002): probability (unipolar), frequency (unipolar) and degree (unipolar or bipolar). In cases where the degree of a unipolar attribute is measured, which is mostly the case in this particular study, the adverbs "not at all" and "extremely " are used as anchor points with the psychological zero point being identified at the minimum "not at all" category. These used along with the intermediate adverbs, "slightly" and "quite" are posited to provide equal intervals by the method of successive-intervals scaling (Cohen, 1987). As such, the combination of a valid psychological zero, a valid minimum and maximum and equal-interval categories, allow for a good approximation of a ratio or 'magnitude' scale and grant legitimacy for the use of parametric statistical tests (Rotisser, 2002). Finally, it should be emphasized the survey instrument's construction in an electronic web-based form permits the use of continuous slider-type response scales over discrete-choice answer formats. As such, the response scales are not limited to seven boxes. Instead, they allow for any response ranging from 0.00 up to 7.00 in 0.01 increment widths.

With regard to unipolar and bipolar ratings, a clarification is in order. While any adjectival description may be held to have a counterpart with exactly the opposite connotative meaning (e.g. good vs. bad, complicated vs. simple) the study holds that the fact does not necessarily impose the use of semantic differential scales by treating the rating of interest as a bipolar one. Instead, the study holds that when the degree of intensity of an issue is inquired, the zero psychological point of an adjectival description simultaneously signifies the maximum intensity of the opposite adjectival description. If for example complexity is an attribute of interest, and the question relates the issue of 'how complicated is X?' the psychological zero point of complexity is identified in the response alternatives with the numerical label of "0" and is further adjoined by the verbal description "not complicated at all" or simply "not at all". This zero point is at the same time held to signify extreme simplicity. While this assumption may be a potential source of bias (Heise, 1969:414), it is nevertheless held as the open-ended interviews with expert judges from the shipping industry indicated the issue to be of negligible influence that would add unnecessary complexity to the survey instrument.

8.2.5 On the study's application of the C-OAR-SE method

Having broadly described the steps of scale development suggested by the C-OAR-SE method this section reports on the procedure's application in this study. As argued by Rossiter (2011), constructs are ultimately defined by the researcher and past research while they are operationalized for a particular use given each study's research design and empirical context requirements. This particular study seeks to explore the hypothesized causal relationships between constructs in a particular empirical setting where servitization phenomena occur (in this case the marine shipping industry). As a result, particular considerations of a more practical nature restrict the formal application of the C-OAR-SE procedure to the letter. Consequently, the study's application of the C-OAR-SE method in light of the restrictions posed by the research's empirical setting proceeded as follows.

At first, each of the study's constructs of interest was defined in terms of its object (including possible constituents or components), attribute (including possible components) and rater entity. Given the specific requirements posed by the research design with regard to the use of senior or otherwise high-level technical and executive shipping firm managers, the rater entity is identified as a group of such managers (each from a different marine shipping firm). Then, the constructs' objects and attributes were classified according to the method's specified object and attribute categories and relevant items were generated to represent them. This initial operationalizing definition was conducted by the researcher (aided by the thesis supervising professor were confusion occurred) and is deemed to be the first attempt at establishing the constructs' item-content validity as an expert-judgment appeal to readers (Nunnally, 1978:94; Rossiter, 2011:1568).

Subsequently, the scale formation part of the development process along with the cross-validation of the initial construct definitions was performed through open-ended interviews with three senior technical managers from three different marine shipping firms (two hailing from Greece and one from England). These three senior executives were treated as expert judges from the marine shipping industry and were instrumental in the refinement of the constructs' definitions. Were two or more judges disagreed with the initial definitions, the definitions would be adjusted as necessary to achieve inter-judge agreement while maintaining that the underlying theoretical constructs were appropriately represented. Furthermore, the same judges' input significantly influenced the scales' content wording and response formats to ensure item-content and answer-scale validity. As such, this process is offered as further evidence of the measurement scales' overall content validity in measuring what is attempted to be measured in the study's empirical context (as per Rossiter, 2011).

8.2.6 On the classification of the constructs' principal objects

Since most, if not all, of the constructs included in this study revolve around some attribute of the study's presumed fixed entities, i.e. six engine maintenance activities, separate mention of the classification of these particular construct objects is warranted. As such, their classification is addressed here and, in the interest of parsimony, will subsequently be referenced to in the rest of this chapter.

The six maintenance activities that were first elaborated upon during the thesis empirical context chapter are:

1. A focal firm's ships' main engine maintenance planning
2. A focal firm's ships' main engine tactical spare parts logistics
3. A focal firm's ships' main engine regular maintenance
4. A focal firm's ships' main engine problem troubleshooting
5. A focal firm's ships' main engine extraordinary spare parts logistics
6. A focal firm's ships' main engine extraordinary repairs

From the previous enumeration of the six activities it is evidenced that all of them refer to maintenance activities targeting the main engine of a marine shipping firm's ships. At the same time, though, they do not refer specifically to a single particular ship's engine from the multitude of ships (and accompanying engines) that a shipping firm may own or control. Rather, each collectively refers to a higher categorical level that bundles all of the different ships engine maintenance processes to a singular concept maintenance activity that spans all of the firm's ships.

As such, when classified as objects of the study's constructs, these activities could, in principle, be held to be abstract collective objects whose constituent elements would be the different individual ships' engine maintenance processes. At closer inspection, though, with literally dozens or even hundreds of ships per shipping firm, the proposition to treat these activities as abstract collective objects with multiple constituents is quickly deemed untenable. Corollary to this, the objects would have to be treated as concrete singular.

Indeed, when the point was specifically discussed during the open-ended interviews with the expert shipping firm executives, it was unanimously conferred that there was practically no other way with which the concept could be conveyed bar its consideration as a concrete singular object. Fortunately, at the same time the expert judges expressed their confidence that the point is a non-issue, in the sense that senior technical and executive managers of shipping firms routinely treat such abstract collective objects as concrete singular ones. In essence then, what is conveyed is that when a question refers to an activity and that activity is simply termed as 'Engine maintenance planning', that activity is understood by shipping firm executives to refer to the bundle of all the engine maintenance planning activities performed in the context of a particular firm.

As such, in the bounds of the survey instrument the activities (i.e. the object's constructs) are simply termed as follows:

1. 'Engine maintenance planning'
2. 'Tactical spare parts logistics'
3. 'Regular engine maintenance'
4. 'Engine problem troubleshooting'
5. 'Extraordinary spare parts logistics'
6. 'Extraordinary engine repairs'

Finally to dispel possible sources of confusion and to ensure that common frames of reference are set for all of the survey's respondents, an explanatory graph delineating each activity's contents and bounds was included in the first page of the survey instrument. Figure 8-2 presents this accompanying graph.

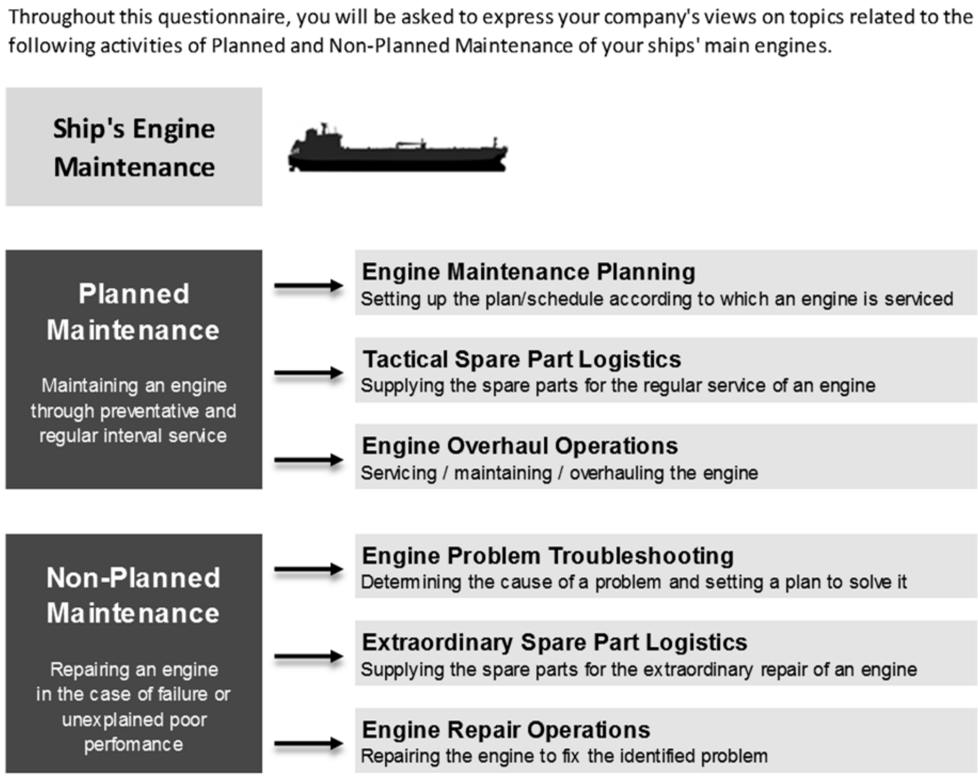


Figure 8-2. Survey instrument graph establishing common frames of reference

8.3 Measurement models development

This section of the thesis reports on the very process of moving from the abstract to the concrete with regard to the issue of measuring the study's theoretical constructs. The process is described for all of the study's constructs of interest including the study's independent variables derived from the four different strategic perspectives, the dependent variable (outcome of interest) as well as an assortment of control variables.

8.3.1 Measurement model for efficiency considerations

Principal's Asset specificity

The first construct of interest with regard to efficiency considerations, is a principal's transaction asset specificity or otherwise the principal's transaction-specific assets. With the term principal reference is made to a focal marine shipping firm identified as a potential customer of servitized offerings. The construct's objects are identified to be the six focal maintenance activities. The construct's attribute is the degree of non-redeployability exhibited by a principal's assets invested in each activity, given that the activity is outsourced to any degree.

In recognizing from previous theory that there are six distinct types of transaction-specific assets, the attribute is identified to be abstract formed. Its components, in turn are the six different types of transaction-specific assets, namely (1) human asset specificity, (2) site asset specificity, (3) physical asset specificity, (4) dedicated asset specificity, (5) procedural asset specificity and (6) temporal asset specificity. Given that in the study's elected empirical context site asset specificity is thought to have no bearing whatsoever, it is dropped from the rest of the measurement development process.

In turn, each of the five remaining types of transaction-specific assets is deemed as a concrete attribute each representing a different type of asset whose degree of non-redeployability is under judgment. As such, given the conceptual definitions provided in the chapter delineating the theoretical background of strategic considerations affecting customer firm boundary decisions, five distinct questions along with their respective answer formats are developed. After many pre-test refinement iterations with regard to the wording of the scales' stems, the following measures were produced:

With regard to a principal's human asset specificity:

To switch to a *different* supplier for each activity, to what degree do you need to change your company's know-how?

	not at all		*slightly*		*quite*		*extremely*
	0 – 1	**1 – 2**	**2 – 3**	**3 – 4**	**4 – 5**	**5 – 6**	**6 – 7**
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

With regard to a principal's physical asset specificity:

To switch to a *different* supplier for each activity, to what degree do you need to change your company's technical infrastructure? (e.g. hardware, software or other technical equipment)

	not at all		*slightly*		*quite*		*extremely*
	0 – 1	**1 – 2**	**2 – 3**	**3 – 4**	**4 – 5**	**5 – 6**	**6 – 7**
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

With regard to a principal's dedicated asset specificity:

To switch to a *different* supplier for each activity, to what degree do you need to change your company's human resources?

	not at all		*slightly*		*quite*		*extremely*
	0 – 1	**1 – 2**	**2 – 3**	**3 – 4**	**4 – 5**	**5 – 6**	**6 – 7**
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

With regard to a principal's procedural asset specificity:

To switch to a *different* supplier for each activity, to what degree do you need to change your company's operating procedures?

	not at all		*slightly*		*quite*		*extremely*
	0 – 1	**1 – 2**	**2 – 3**	**3 – 4**	**4 – 5**	**5 – 6**	**6 – 7**
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

With regard to a principal's temporal asset specificity, a slightly varying definition in relation to the previous types is used. Temporal specificity refers to the importance of timing and coordination in a given transaction (here, in maintenance activities). As such, the associated measurement scale is formed as:

How important is timing and on-time delivery in each activity?

	0–1 *not at all*	1–2	2–3 *slightly important*	3–4	4–5 *quite important*	5–6	6–7 *extremely important*
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

Principal's Proprietary Asset Exposure

The construct once again focuses on a principal marine shipping firm, and while closely related to asset specificity centres on slightly different issues. The construct's objects are once again the six focal maintenance activities. The relevant attribute is the degree to which a focal principal firm's proprietary assets, including brand name capital, intellectual property and privileged information, are exposed to expropriation in each activity. The construct's attribute under judgment is considered abstract formed and its components (deemed as concrete) are the three aforementioned types of proprietary assets. As with site asset specificity, the exposure of intellectual property is thought to have no bearing in the particular empirical context. As such, the following measures were produced:

With regard to brand name capital (i.e. a principal's reputation) exposure, it is held that the stronger the influence of an activity's performance level to the principal's reputation the higher the level of the proprietary asset's exposure is. As such, the relevant question formed is:

How important is good performance in each activity to your company's reputation?
(i.e. poor performance hurts your company's reputation)

	0–1 *not at all*	1–2	2–3 *slightly important*	3–4	4–5 *quite important*	5–6	6–7 *extremely important*
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

With regard to the exposure of a principal's privileged information, the scale focuses on the frequency at which such information becomes available to the transaction's (i.e. activity's) partners (i.e. the activity's suppliers). Furthermore, to delineate the notion of privileged information, the latter is held to be privileged for the reason of being of value to third parties (i.e. the principal's competitors). Therefore the relevant question becomes:

How often do suppliers gain information about your operations that would be valuable to your competitors?
In each activity:

	0–1 *hardly ever*	1–2	2–3 *sometimes*	3–4	4–5 *usually*	5–6	6–7 *all the time*
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

Agents' Asset specificity

The construct of agents' asset specificity along with the related construct of agents' proprietary asset exposure is, in essence, the mirror image of the construct of a principal's asset specificity. The key difference is that it refers to the non-redeployability of assets exposed in each activity on behalf of the principal's transacting partners (i.e. each activity's suppliers). The six focal activities naturally remain as the construct's objects, while the attribute under judgement is respectively thought to be formed and composed of the five different kinds of transaction-specific assets as represented in human, physical, dedicated, procedural and temporal asset specificity.

In contrast, though, the consultation of expert judges from the marine shipping industry, indicated that a different wording approach than that used for the principal's asset specificity is more appropriate in targeting the agents' asset non-redeployability characteristics. As such, instead of wording the questions in terms of changes needed to supply a different client, the content focuses on the level of the assets' specialization to the particular needs of the principal as that specialization is observed by the principal's managers. Indeed, asking a principal's managers to pass direct judgment on other principal-agent relationships would be irrational and not based on actual experience. Given the foregoing points, the following measures were produced:

With regard to agents' human asset specificity:

How specialized is your suppliers' know-how to your company's particular needs?

In each activity:

	not at all		*slightly specialized*		*quite specialized*		*extremely specialized*
	0 – 1	**2**	**3**	**4**	**5**	**6**	**7**
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

With regard to agents' physical asset specificity:

How specialized is your suppliers' technical infrastructure to your company's particular needs?

(e.g. hardware, software or other technical equipment)

In each activity:

	not at all		*slightly specialized*		*quite specialized*		*extremely specialized*
	0 – 1	**2**	**3**	**4**	**5**	**6**	**7**
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

With regard to agents' dedicated asset specificity:

How specialized are your suppliers' human resources to your company's particular needs?

In each activity:

	not at all		*slightly specialized*		*quite specialized*		*extremely specialized*
	0 – 1	**2**	**3**	**4**	**5**	**6**	**7**
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

With regard to agents' procedural asset specificity:

How specialized are your suppliers' operating procedures to your company's particular needs?

In each activity:	0	1	2	3	4	5	6	7
	not at all		*slightly specialized*		*quite specialized*		*extremely specialized*	
Engine maintenance planning:								
Engine problem troubleshooting:								
Tactical spare part logistics:								
Extraordinary spare part logistics:								
Regular engine maintenance:								
Extraordinary engine repairs:								

With regard to agents' temporal asset specificity, once more the varying definition previously associated with the principal's temporal asset specificity is utilized. Accordingly, temporal specificity here refers to the importance of timing and coordination in a maintenance activity on behalf of the principal's transacting partners (i.e. the activity's suppliers). This time, however, to primarily provide a concrete anchoring reference point for the survey's respondents (i.e. a principal's managers), timing and on-time delivery is further tied specifically with the agent's compensation regime by the principal.

More specifically, it is held that the higher the influence of timing and on-time delivery to the agents' compensation regime is, the higher the importance of timing and on-time delivery for the agents. This associating assertion is based on the assumption of incentives alignment. Although the approach is targeting the focal issue by proxy, it is held as a reasonable compromise allowing the respondents to rely on experience and not pass direct judgment on the agents' inner corporate workings. As such, the relevant question formed is:

How much does timing and on-time delivery influence supplier compensation in each activity?

	0	1	2	3	4	5	6	7
	not at all		*slightly*		*quite*		*extremely*	
Engine maintenance planning:								
Engine problem troubleshooting:								
Tactical spare part logistics:								
Extraordinary spare part logistics:								
Regular engine maintenance:								
Extraordinary engine repairs:								

Agents' Proprietary Asset Exposure

The construct of agents' proprietary asset exposure echoes that of a principal's proprietary asset exposure. The construct focuses on a principal's transacting partners (i.e. an activity's suppliers) while the construct's objects are, once again, the six focal maintenance activities. The relevant attribute under judgment is the degree to which agents' proprietary assets, including brand name capital and privileged information are exposed to expropriation (by the principal this time) in each activity. The construct's attribute is similarly considered abstract formed and its components (deemed as concrete) are the two aforementioned types of proprietary assets. Subsequently the following measures were produced:

With regard to brand name capital (i.e. the agents' reputation) exposure, it is held that a maintenance activity's performance levels directly impact a maintenance supplying firm's reputation (be it in a good way or a bad one). The assumption is based on the pragmatic acknowledgement that the end-result is what really matters in the heavily functionalistic, and often legalistic, context of marine shipping. As such, contrary to the principal's case were the end-result is the transportation of cargo from point A to point B, and subsequently the reputational effects of maintenance activity performance levels are free to vary, in the agents' (maintenance suppliers) case, the end-result is the very performance of the focal maintenance activities themselves. Consequently, in keeping that performance levels directly affect the agents' reputation, focus is put on the visibility of that performance to other companies (i.e. other potential customers of agents) in the sector. As a result, the relevant question is formed as:

How visible is your suppliers' performance in the activity to other companies in your sector?

For each activity:							
	not at all		*slightly visible*		*quite visible*		*extremely visible*
	0 — 1	**2**	**3**	**4**	**5**	**6**	**7**
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

With regard to the exposure of agents' privileged information, the scale focuses on the frequency with which such information becomes available to the principal. Much like in the case of a principal's privileged information, the notion of privileged information is exemplified through its consideration as information that can be of value to third parties (in this case, the agents' competitors). Resultantly, the relevant question is formed as:

How often do you gain information about your supplier's operations that would be valuable to their competitors?

In each activity:							
	hardly ever		*sometimes*		*usually*		*all the time*
	0 — 1	**2**	**3**	**4**	**5**	**6**	**7**
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

Behavioural Uncertainty

Behavioural uncertainty is one of the central constructs included in the study's exploration of efficiency considerations. The construct's objects are once again the six focal activities while the attribute under judgment here is the perceived level of behavioural unpredictability bestowed on maintenance suppliers in each activity. Said unpredictability is essentially equated with the perceived probability that suppliers might engage in any form of opportunistic behaviour that could herald manifest or latent contractual infractions. In conferences with expert judges from the marine shipping industry, two approaches to the measurement of the construct were put forth.

The first related with its consideration as an eliciting attribute as one could convey the notion that it is a construct representing an 'internal' trait or perceptual disposition (state). Nevertheless, all expert judges agreed that the construct's interpretation as unpredictable behaviour exhibited in corporate rather than any form of personal terms was relatively concrete. Additionally, during the item generation phase of the construct's consideration as an eliciting attribute, the items generated were found to relate more to notions of actualized and proven (i.e. factual) unpredictability rather than perceived unpredictability. For example, two of the items considered included inquiries surrounding the frequency with which suppliers exaggerate their needs or alter facts, or the frequency with which they breach formal or informal agreements (as suggested by Skarmeas et al., 2002). At that point, however, the expert judges pointed out a number of problematic issues and advised against the use of such measures principally due to an increased potential for social (or in this case corporate) desirability bias.

The second approach related with the consideration of the attribute as a concrete one, and in particular one directly associated with reliability issues. In other words, the expert judges consented that the construct is more than adequately captured with the notion of perceived reliability. As such, the final scale developed for the construct of behavioural uncertainty was reverse coded and articulated in the following deceptively simple way:

How reliable do you think that the suppliers are?
In each activity:

	not at all		*slightly*		*quite*		*extremely*
0	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

Market/Volume Uncertainty

Market/volume uncertainty or simply volume uncertainty is related with the inability to accurately forecast the volume requirements of an exchange (i.e. a transaction, or in this case a maintenance activity). As such, the construct's objects are yet again the six focal maintenance activities while the construct's attribute (held to be a concrete one) is defined as the difficulty with which the focal firm can predict its demand levels for each activity. As such, and with inspiration drawn from John and Weitz (1988), the following measure was produced:

How difficult is it to predict your company's demand for each activity?

	not at all		*slightly difficult*		*quite difficult*		*extremely difficult*
0	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

Technological Uncertainty

The construct of technological uncertainty refers to technological volatility, or otherwise the inability to accurately forecast future technological developments related with the construct's objects, which once more include the six focal maintenance activities. The construct's attribute, in contrast to the case of volume uncertainty, is held to be abstract formed. Two concrete components are thought to form it in a composite (multiplicative) manner. The first component, inspired by Walker and Weber (1984), relates to the speed with which the relevant technology evolves, while the second component, inspired by Stump and Heide (1996), relates to the unpredictability of relevant technological developments.

Through the multiplication of the two components to form the construct of technological uncertainty, it is inferred that while technological developments may be unpredictable to a degree, uncertainty is further exacerbated by the speed of their development. Similarly, even if technological developments occur at a rapid pace, low unpredictability levels allow the curbing of technological uncertainty. Given the foregoing points, the following measures were produced (with the unpredictability component being reverse-coded):

With regard to the speed of technological developments:

How rapid are technological developments in tools, methods and equipment in each activity?

	not at all		*slightly rapid*		*quite rapid*		*extremely rapid*
0	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

With regard to the unpredictability of technological developments (reverse-coded):

How predictable are technological developments in each activity?

	not at all		*slightly predictable*		*quite predictable*		*extremely predictable*
0	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

Value Assessment Ability

The construct of value assessment ability generally refers to a focal firm's ability to assess the value of the goods or services exchanged in a given transaction. In the study's empirical setting, it specifically refers to a focal shipping firm's ability to assess the value of tasks included in the six focal maintenance activities (i.e. the construct's objects). As such, the construct's attribute, considered a concrete one, is defined as the ease of pricing the tasks included in each activity. Subsequently, the following measure (reverse-coded) was produced:

How difficult is it to price the tasks included in each activity?

	not at all		*slightly difficult*		*quite difficult*		*extremely difficult*
0	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

Contribution Assessment Ability

The construct of contribution assessment ability, in general, refers to a focal firm's ability to ascertain ex-post whether the contract terms of an exchange were adequately satisfied or in the words of Geyskens et al. (2006) "whether contractual compliance has taken place". In this study's empirical context the construct refers specifically to a focal shipping firm's ability to assess a maintenance supplier's contributions in the context of the focal maintenance activities (i.e. the construct's objects). Accordingly, the construct's attribute, considered a concrete one, is defined as the ease of evaluating a supplier's performance in each activity. Thus, the following measure (reverse coded) was produced:

How difficult is it to evaluate a supplier's performance in each activity?

	not at all		*slightly difficult*		*quite difficult*		*extremely difficult*
0	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

Transaction Frequency

The construct of transaction frequency simply refers to the extent to which a transaction (or in this case a maintenance activity) recurs. Thus, the construct's objects are once more the six focal maintenance activities while the construct's attribute (held as concrete) is defined simply as the frequency at which a focal shipping firm necessitates each maintenance activity. To represent various valid degrees of frequency, given the idiosyncrasies of the focal maintenance activities, an appropriate temporal scale was developed through the consultation of expert judges and industry archival sources. Given the foregoing points, the following measure was produced:

How often do you engage in or need each activity?

	every five years	*every two years*	*every year*	*every semester*	*every month*	*every week*	*every day*
0	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

8.3.2 Measurement model for dependency considerations

Power Imbalance

The core construct with regard to dependency considerations, as articulated by resource dependency theory, is power imbalance. In general, power imbalance refers to the difference between two actors' dependencies. In the study's context, the construct refers to the difference between the principal's dependency on agents and the agent's dependency on principals in the context of the six focal maintenance activities (identified as the construct's objects). As such, the construct's attribute is deemed to be abstract formed with the two types of dependencies forming it in a composite (subtractive) manner. Given past research, the two different dependency attributes are themselves considered as abstract formed (thus rendering power imbalance a second-order formed attribute). Two concrete attributes, in turn, form each of the first-order dependency attributes again in a composite (though this time multiplicative) manner.

In the case of a principal's dependence on agents, the two concrete zero-order attributes that form it are the principal's exchanged resource criticality and the principal's availability of alternative supply sources. In the case of the corresponding agent's dependence on principals, the two zero-order attributes that form it are the agent's exchanged resource criticality and the agent's availability of alternative supply outputs. Focusing on the attribute of the principal's exchanged resource criticality it is defined as the degree to which the potentially exchanged resource, in this case a maintenance activity, is essential to the functioning and daily operations of the principal (i.e. a focal marine shipping firm). The principal's availability of alternative supply sources attribute, in turn, refers to the number of alternative maintenance suppliers from which the principal may realistically procure each activity. Given the aforementioned definitions for the zero-order attributes that form the first order attribute of a principal's dependence on agents, the following measures are produced:

With regard to a principal's exchanged resource criticality:

How critical is each activity to your company's ability to conduct business?

	not at all 0	1	2	*slightly critical* 3	4	*quite critical* 5	6	*extremely critical* 7
Engine maintenance planning:								
Engine problem troubleshooting:								
Tactical spare part logistics:								
Extraordinary spare part logistics:								
Regular engine maintenance:								
Extraordinary engine repairs:								

With regard to a principal's availability of alternative supply sources:

Approximately how many suppliers do you use for each activity *(number of suppliers used)*, **and from how many other suppliers can you realistically procure each activity** *(number of other suppliers)* **?**

	number of suppliers used:	*number of other suppliers:*
Engine maintenance planning:		
Engine problem troubleshooting:		
Tactical spare part logistics:		
Extraordinary spare part logistics:		
Regular engine maintenance:		
Extraordinary engine repairs:		

Focusing on the attribute of the agent's exchanged resource criticality or essentiality, first and foremost, it is evident that a maintenance activity is no longer the exchanged resource. Instead, what the principal provides the agent for the provision of a maintenance activity is remuneration. In other words, in this case, it is monetary resources (i.e. an amount of currency) that are being exchanged. Thus, a different content wording approach than that used in the case of a principal's exchanged resource criticality is utilized here to emphasize the criticality of monetary resources in the functioning and daily operations of the agent. Finally, the agent's availability of alternative supply outputs refers to the number of alternative firms that could realistically make use of the agent's services rendered. Given the aforementioned definitions for the zero-order attributes that form the first order attribute of an agent's dependence on principals, the following measures are produced:

With regard to an agent's exchanged resource criticality (reverse-coded):

How financially secure are your suppliers in general?

In each activity:	0	*not at all* 1	2	*slightly secure* 3	4	*quite secure* 5	6	*extremely secure* 7
Engine maintenance planning:								
Engine problem troubleshooting:								
Tactical spare part logistics:								
Extraordinary spare part logistics:								
Regular engine maintenance:								
Extraordinary engine repairs:								

The rationale behind this question being that the less financially secure suppliers are, the more critical monetary resources become.

With regard to an agent's availability of alternative supply outputs:

Approximately how many other firms do your suppliers serve in each activity *(number of other firms served)* **,**
and how many additional firms could realistically make use of their services *(number of potential client firms)* **?**

	number of other client firms:	*number of potential client firms:*
Engine maintenance planning:		
Engine problem troubleshooting:		
Tactical spare part logistics:		
Extraordinary spare part logistics:		
Regular engine maintenance:		
Extraordinary engine repairs:		

Finally, a few comments are in order with regard to the way that the overarching construct of power imbalance is formed. Firstly, it bears mentioning that the principal's availability of alternative supply sources and the agent's availability of alternative supply outputs, are calculated through the addition of 'number of suppliers used' and 'number of other suppliers' in the case of the principal, and through the addition of 'number of other client firms' and number of potential client firms' for the agent.

Secondly, it should further be underlined that in the formation of the first-order attributes of a principal's dependency on agents and an agent's dependency on principals the corresponding exchanged resource criticalities are not to be multiplied directly with the availability of alternative supply sources and outputs respectively. Instead, according to Jacobs (1974), they are to be multiplied with 1 over the total number of available supply sources and 1 over the total number of available supply outputs respectively. In the interest of clarity these new transformed quantities are labelled 'Principal's potential for oligopolistic suppliers' and 'Agent's potential for oligopsonistic clients' respectively, to more accurately portray the quantities' conceptual meaning.

Given the above, the second-order attribute of the power imbalance construct, is calculated by subtracting the agent's dependency on principals from the principal's dependency on agents. As such, based on the dependency consideration's posited causal relationship, the lower the subtraction's result is the more favourable the power imbalance is towards the principal, and thus the more outsourced a focal activity is likely to be.

To more explicitly depict the power imbalance construct's formation, the processes described previously are hierarchically further exemplified below in an equation format:

Power imbalance = Principal's dependency on agents – Agent's Dependency on principals

Power imbalance = (Principal's res. criticality * Principal's potential for oligopolistic suppliers) – (Agent's res. criticality * Principal's potential for oligopsonistic clients)

Power imbalance = [Principal's res. criticality * (1 / Availability of alternative supply sources) – (Agent's res. criticality * (1 / Availability of alternative supply outputs)]

Power imbalance = {Principal's res. criticality * [1 / (n of suppliers used + n of other suppliers)] – {Agent's res. criticality * [1 / (n of other client firms + n of pot. client firms)]

Resource Internalization Potential

The construct of resource internalization potential refers to the ease or difficulty with which a principal (i.e. a focal firm) may internalize (i.e. in-source) a focal resource. The construct's objects are, once more, recognized to be the six focal maintenance activities, while the construct's attribute, held to be of a concrete nature, is the degree of difficulty with which a focal marine shipping firm may entirely internalize each maintenance activity (given that the activity is outsourced to any degree, of course). Furthermore, to provide a more solid frame of reference for the survey's respondents, as per the instructions provided by expert judges form the marine shipping industry, the notion of difficulty in internalizing an activity was further tied to the process's requirements in terms of time and money. As such, the following measure was produced:

How difficult is it to fully develop each activity internally?
(in terms of time and money)

	not at all		*slightly difficult*		*quite difficult*		*extremely difficult*
	0 – 1	**1 – 2**	**2 – 3**	**3 – 4**	**4 – 5**	**5 – 6**	**6 – 7**
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

Cooptation Potential

The construct of cooptation potential refers to the ability of a principal (i.e. a focal firm) to influence an agent (i.e. a focal firm's supplier) by creating vested interests through socialization, information sharing or even participation in the agent's managerial boards. In this study's case, the construct is operationalized simply as the ability of a focal marine shipping firm in influencing the strategic decisions of a maintenance activity's supplier. As such, the construct's objects are the six focal maintenance activities, while the construct's attribute, considered as a concrete one and defined in-line with the previously reported contextual specification, is measured through the following scale:

To what degree can your company influence your suppliers' strategic decisions?
In each activity:

	not at all		*slightly*		*quite*		*extremely*
	0 1	2	3	4	5	6	7
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

Agent Actual Dependence

The construct of agent actual dependence refers to a principal's contribution to an agent's circle of operations. In this study's case, the construct thus refers to a focal marine shipping firm's contribution to a maintenance activity supplier's operating revenue in the context of the six focal maintenance activities (i.e. the construct's objects). The construct's attribute is held to be a concrete one and is measured through an estimate of a focal shipping firm's percentage contribution to each activity's supplier income. Thus, the following measure was produced:

Approximately how much of your supplier's business (income) do you represent?
In each activity, expressed as a percentage:

	Contribution to supplier income (%):
Engine maintenance planning:	
Engine problem troubleshooting:	
Tactical spare part logistics:	
Extraordinary spare part logistics:	
Regular engine maintenance:	
Extraordinary engine repairs:	

8.3.3 Measurement model for competence considerations

Resource Value

The overall construct of resource value refers to a resource's contribution to higher gains and/or lower costs for the interested focal firm. For this study's purposes, the overarching construct is operationalized separately for each contributing condition. Thus reference is made to the construct of contribution to higher gains and the construct of contribution to lower costs. In both cases, the constructs' objects are once more the six focal maintenance activities identified as resources that can contribute to higher gains and/or lower costs for the focal firm.

With regard to the construct of contribution to higher gains, a resource (in this case a maintenance activity) is deemed to contribute to higher gains if it increases the customer's willingness to pay (WTP) or it increases the customer's perceived benefits. At this point, is should be underlined that when referring to customers here, the reference is directed towards the customers of marine shipping firms rather than the shipping firms themselves. Given the above, the construct of contribution to higher gains is deemed as an abstract formed attribute whose concrete components form it in a composite (summative) manner and include the contribution to higher willingness to pay and contribution to higher perceived benefits. The summative way with which the first-order construct of contribution to higher gains is formed, is meant to portray the notion that an increase in either WTP or perceived benefits contributes equally to a focal firm's higher gains. Given the foregoing points the following measures were produced:

With regard to contribution to higher willingness to pay:

To what degree does each activity allow you to offer your services at higher prices compared to your competitors?

	not at all 0	1	2 *slightly*	3	4 *quite*	5	6 *extremely* 7
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

With regard to contribution to higher perceived benefits:

To what degree does each activity increase the benefits perceived by your customers?

	not at all 0	1	2 *slightly*	3	4 *quite*	5	6 *extremely* 7
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

With regard to the construct of contribution to lower costs, a resource (i.e. a maintenance activity) is deemed to contribute to lower costs if it allows for the more economic production of a good or rendering of a service. In the study's context the construct is operationalized as the degree to which a maintenance activity allows for the economic rendering of a focal shipping firm's cargo transportation services. As such, the construct's attribute is deemed as a concrete one and the scale developed for its measurement is as follows:

To what degree does each activity allow you to compete on costs?

	not at all 0	1	2 *slightly*	3	4 *quite*	5	6 *extremely* 7
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

Potential Resource Value

The construct of potential resource value refers to the potential contributions of a resource (i.e. a maintenance activity) towards higher gains and/or lower costs for a focal firm in the future. Thus, the six focal maintenance activities remain once more as the construct's objects. Nevertheless, due to the fact that the construct aspires to capture evaluations of future states, the separate dimensions of contributions to higher gains and contributions to lower costs are not treated as separate subordinate constructs (as was the case with the construct of resource value). Rather, the overarching construct's attribute is held to be abstract formed and composed by its concrete components in a composite (summative) manner.

The two components are limited to a resource's potential contribution to higher willingness to pay and a resource's potential contribution to the more economic rendering of a shipping firm's services. The issue of potential higher perceived benefits is dropped here as it is deemed far too removed from the respondent's frame of reference to meaningfully provide substantial input.

This was a point further corroborated by expert judges from the marine shipping industry. The summative manner with which the two zero-order attributes are composed to form the first-order attribute is meant to convey the notion that an increase to either potential contribution to higher gains or potential contribution to lower costs results in increased potential resource value. Finally, as the construct refers to future states, the content wording and scale part of the relevant measures is appropriately adjusted to represent degrees of likelihood. Given the foregoing discussion the following measures were produced:

With regard to potential contribution to higher willingness to pay:

How likely is each activity to allow you to offer your services at higher prices compared to your competitors in the future?

	not likely at all		*slightly likely*		*quite likely*		*extremely likely*
	0–1	**1–2**	**2–3**	**3–4**	**4–5**	**5–6**	**6–7**
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

With regard to potential contribution to lower costs:

How likely is each activity to allow you to compete on costs in the future?

	not likely at all		*slightly likely*		*quite likely*		*extremely likely*
	0–1	**1–2**	**2–3**	**3–4**	**4–5**	**5–6**	**6–7**
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

Natural Resource Scarcity

The construct of natural resource scarcity refers to the limited size of a resource's supply base or otherwise its limited availability in factor markets. The key operative notion in this construct is the availability of a resource (i.e. a maintenance activity) in *factor markets*. In other words, the construct is concerned with the availability of prime factors of production for a resource. In this study's case, the construct refers to the availability of prime factors for the rendering of a maintenance activity. As such, the construct retains the six focal activities as its objects while the attribute under judgment is the aforementioned availability of said prime factors. Upon conference with expert judges from the marine shipping industry, it was concluded that the issue gravitates towards human resource concerns and that the availability of such prime factors principally refers to the availability of professionals experienced in each activity's tasks. Furthermore, based on input from the same expert judges, the limited availability concept is operationalized through the perceived difficulty of recruiting such experienced professionals. As such, the construct's attribute is held to be concrete and the following scale was produced for its measurement:

How difficult is it to find and recruit experienced professionals for each activity?

	not at all		*slightly difficult*		*quite difficult*		*extremely difficult*
0	1	2	3	4	5	6	7
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

Resource Inimitability

The construct of resource inimitability is a higher-order construct of an abstract formed nature in that it is composed by the constructs of unique historical conditions, intrafirm causal ambiguity, interfirm causal ambiguity and social complexity. In all of the constructs' cases, the objects of interest are identified to be the study's six focal maintenance activities. Of the four constructs perceived to form resource inimitability, the construct of unique historical conditions is not deliberated any further as it is thought to have no bearing in the particular empirical context. Thus, the operationalization process continues with the remaining three resource inimitability constructs.

Intrafirm causal ambiguity is a construct referring to the ambiguity present among a focal firm's decision makers with regard to a resource's (in this case a maintenance activity's) impact on a focal firm's bottom-line performance. Given past research, the construct's attribute is itself considered as abstract formed with resource complexity, resource tacitness and resource distance to performance being regarded as its forming components. The forming components are all regarded as concrete attributes and they form the construct of intrafirm causal ambiguity in a composite (summative) manner. With the summative composition of the overarching construct it is conveyed that causal ambiguity is equally increased through an increase in any of the three forming components.

With regard to resource complexity, the attribute theoretically refers to a resource's dependence on complex interactions of human and technological systems for its performance. In the study's context, the attribute is considered as a concrete one and is simply held to target the respondents' perceived level of complexity associated with the tasks included in each maintenance activity. As such the following measure was produced:

How complicated are the tasks included in each activity?

	not at all		*slightly complex*		*quite complex*		*extremely complex*
0	1	2	3	4	5	6	7
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

With regard to resource tacitness, the attribute refers to the conscious or unconscious nature of the tasks comprising a resource and inquires the resource's level of definitional clarity. In the study's context then, the attribute refers to the definitional clarity surrounding the tasks included in a maintenance activity. As such, the attribute is considered as a concrete one and is operationalized through the following (reverse-coded) measure:

How well-defined are the tasks included in each activity?

	0	1	2	3	4	5	6	7
		not at all		*slightly defined*		*quite defined*		*extremely defined*
Engine maintenance planning:								
Engine problem troubleshooting:								
Tactical spare part logistics:								
Extraordinary spare part logistics:								
Regular engine maintenance:								
Extraordinary engine repairs:								

With regard to resource distance to performance, the attribute refers to the spatial and temporal distance between a resource's use and the observation of its value-enhancing contribution. In the study's context, the attribute, operationalized as a concrete one, is held to refer to a maintenance activity's obscurity or otherwise low visibility in formal intrafirm performance appraisals. As such, the following (reverse-coded) measure was produced:

How visible is each activity in formal performance measures in your company?

	0	1	2	3	4	5	6	7
		not at all		*slightly visible*		*quite visible*		*extremely visible*
Engine maintenance planning:								
Engine problem troubleshooting:								
Tactical spare part logistics:								
Extraordinary spare part logistics:								
Regular engine maintenance:								
Extraordinary engine repairs:								

Interfirm causal ambiguity is a construct referring to the causal ambiguity present between a focal firm and its peer competing firms. In the present study, given the justifications provided in chapter 5, the construct is operationalized solely through the attribute of resource interconnectedness. The latter attribute refers to the level to which a resource is connected interactively with other resources in the focal firm. In the study's context, thus, the attribute refers to the level to which a maintenance activity is connected interactively with other activities of a focal marine shipping firm. As such, the attribute is considered as a concrete one and is operationalized through the following measure:

How connected is each activity to the rest of your company's operations?

	0	1	2	3	4	5	6	7
		not at all		*slightly connected*		*quite connected*		*extremely connected*
Engine maintenance planning:								
Engine problem troubleshooting:								
Tactical spare part logistics:								
Extraordinary spare part logistics:								
Regular engine maintenance:								
Extraordinary engine repairs:								

Social complexity, finally, refers to the degree to which a resource is determined by very complex social phenomena. Due to the lack of any further clarifying theoretical insights as to the attribute's composition and forming characteristics, in the study's context it is simply proxied through an estimation of the number of a focal shipping firm's employees that are assigned to each of the focal maintenance activities. As such, the following measure was produced:

How many of your firm's employees are assigned to each activity?

	number of employees:
Engine maintenance planning:	
Engine problem troubleshooting:	
Tactical spare part logistics:	
Extraordinary spare part logistics:	
Regular engine maintenance:	
Extraordinary engine repairs:	

8.3.4 Measurement model for identity considerations

Resource-Identity Coherence

At the core of identity-based considerations of firm boundary decisions lies the construct of resource-identity coherence. The resource-identity coherence construct refers to the degree to which a resource is coherent with a focal firm's established organizational identity. As such, the construct's objects are once more identified to be six focal maintenance activities. In the study's context, the construct's attribute (deemed as a concrete one) refers to the level of alignment exhibited between a maintenance activity and a marine shipping firm's corporate identity. Thus, the following scale was produced for its measurement:

How aligned is each activity with your company's corporate identity?

	not at all		*slightly aligned*		*quite aligned*		*extremely aligned*
	0 – 1	**1 – 2**	**2 – 3**	**3 – 4**	**4 – 5**	**5 – 6**	**6 – 7**
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

Institutional forces influence

The construct of institutional forces influence refers to the degree to which a focal firm's sourcing decisions are influenced by the particular business sector's institutional forces (i.e. regulatory bodies, or other potentially influencing non-competitive business entities). In the study's context the construct's attribute (held to be a concrete one) refers to the degree to which organizations such as the International Maritime Organization (IMO), classification societies, underwriters or other related business entities influence a focal marine shipping firm's sourcing decisions. Markedly, the construct's objects do not include the six focal maintenance activities. Instead, the construct's object is recognized to be the focal firm itself. As such, the following measure was produced:

To what degree is your sourcing strategy influenced by industry regulating and other organizations?
(e.g. the IMO, classification societies, underwriters, etc.)

not at all		*slightly*		*quite*		*extremely*
0 – 1	**1 – 2**	**2 – 3**	**3 – 4**	**4 – 5**	**5 – 6**	**6 – 7**

Industrial forces influence

The construct of industrial forces influence refers to the degree to which a focal firm's sourcing decisions are influenced by the particular business sector's industrial forces (i.e. collective firm associations, industry leaders and key competitors). In a fashion similar to the case of the institutional forces influence construct, this construct's object is the focal marine shipping firm. As such, the following measure was produced:

To what degree is your sourcing strategy influenced by other shipping firms?
(e.g. Shipping Associations, industry leaders, etc.)

0	1	2	3	4	5	6	7
	not at all		*slightly*		*quite*		*extremely*

8.3.4 Measurement model for the dependent variable

The study's dependent construct or otherwise the study's dependent variable is the construct of activity outsourcing. In general, the construct is defined as the level of outsourcing exhibited by a focal firm in a given activity. In the study's context, the construct refers specifically to the level of outsourcing exhibited by a marine shipping firm in six focal maintenance activities that, expectedly act as the construct's objects of interest.

The outsourcing construct's attribute is operationalized in the study as an abstract formed entity. Its components are deemed to include the outsourcing of an activity's performance (otherwise referred to also as activity performance outsourcing) as well as the outsourcing of an activity's responsibility (or activity responsibility outsourcing). To derive a unique overall level of activity outsourcing, the overarching construct attribute is composed by the two components in a composite (summative) manner. In operationalizing the construct in this way, it is recognized that while an activity's performance may be outsourced to any degree, the responsibility (or culpability, or liability) for the effective performance of the same activity may independently be outsourced or not (again, to any degree). Yet, the more of an activity's performance or responsibility is outsourced, the more outsourced an activity is overall considered to be.

The corresponding measures developed for the component attributes capture the level of outsourcing, be it that of performance or responsibility, through a 100 point (or 100%) scale where points are distributed among four discrete activity-performing or responsibility-bearing business entities. These include: (1) the focal company, (2) an engine designer/manufacturer, (3) a collaborating shipyard and (4) a third-party associate. As such, the measures not only capture the level of an activity's outsourcing but also the type of suppliers utilized. In the interest of clarity and practical space-related considerations four associated yet discrete measure items were produced:

With regard to the responsibility outsourcing of activities related to planned maintenance:

Who is responsible for your ships' Planned Engine Maintenance function?
Please distribute 100 percentage points per activity (column):

	Engine maintenance planning	*Tactical spare part logistics*	*Regular engine maintenance*
Our company or subsidiary/sister firm:	%	%	%
Engine designer/manufacturer:	%	%	%
Collaborating shipyard:	%	%	%
Third-party associate:	%	%	%
Total:	100 %	100 %	100 %

With regard to the performance outsourcing of activities related to planned maintenance:

Who actually performs your ships' Planned Engine Maintenance?
Please distribute 100 percentage points per activity (column):

	Engine maintenance planning	*Tactical spare part logistics*	*Regular engine maintenance*
Our company or subsidiary/sister firm:	%	%	%
Engine designer/manufacturer:	%	%	%
Collaborating shipyard:	%	%	%
Third-party associate:	%	%	%
Total:	100 %	100 %	100 %

With regard to the responsibility outsourcing of activities related to non-planned maintenance:

Who is responsible for your ships' Non-Planned Engine Maintenance function?
Please distribute 100 percentage points per activity (column):

	Engine problem troubleshooting	*Extraordinary spare part logistics*	*Extraordinary engine repairs*
Our company or subsidiary/sister firm:	%	%	%
Engine designer/manufacturer:	%	%	%
Collaborating shipyard:	%	%	%
Third-party associate:	%	%	%
Total:	100 %	100 %	100 %

With regard to the performance outsourcing of activities related to non-planned maintenance:

Who actually performs your ships' Non-Planned Engine Maintenance?
Please distribute 100 percentage points per activity (column):

	Engine problem troubleshooting	*Extraordinary spare part logistics*	*Extraordinary engine repairs*
Our company or subsidiary/sister firm:	%	%	%
Engine designer/manufacturer:	%	%	%
Collaborating shipyard:	%	%	%
Third-party associate:	%	%	%
Total:	100 %	100 %	100 %

8.3.5 Measurement model for control variables

Firm Size

The construct of firm size simply relates to the size of a focal firm under consideration. As such, the construct's object is a focal marine shipping firm. For the operationalization of the size attribute, four separate concrete attribute measures were developed. The first two measures focus on human resource size aspects and include the number of focal firm employees on shore and the number of focal firm employees at sea. The remaining two measures are more asset related and include the number of ships that the focal firm owns or controls as well as the total ship dead weight tonnage (DWT) commanded by the focal firm. Three discrete measure items were produced:

With regard to the number of employees on shore and at sea:

How many employees does your company have?

Number of on-shore employees:	
Number of employees at sea:	

With regard to the number of ships owned or controlled:

How many ships does your company own and how many ships does it control through bareboat charter contracts?

	Dry Cargo Ships	*Wet Cargo Ships*	*Container Ships*	*LPG/LNG Carriers*	*Reefer Ships*	*Other Ships*
Ships owned:						
Ships controlled (bareboat charters):						

With regard to the total dead weight tonnage:

What is approximately your ships' total dead weight tonnage?	
Approximate total DWT of all ships:	

Firm Age

The construct of firm age simply relates to the number of years that a focal firm has been operating in a given industry segment. The construct's object is once again a focal marine shipping firm and the construct's attribute, held to be a concrete one, is operationalized through the following measure:

How long has your company been engaged in deep sea shipping?	
Approximate number of years:	

Average Ship Age

The construct of average ship age relates to the average age of the ships owned or controlled by a focal marine shipping firm. The construct's object is the focal shipping firm and the construct's attribute, held also to be a concrete one is operationalized through the following measure:

What is the average age of the ships that your company owns or controls?	
Approximate number of years:	

8.4 Survey instrument design and construction

This section reports on a number of issues related with the design, layout and final implementation of the study's survey instrument. Primarily, the section deals with a number of design and ordering related issues while subsequently focus is put on the survey instrument's final construction through the use of an appropriate web-based survey research platform.

8.4.1 A few layout design considerations

When constructing a survey instrument (i.e. a questionnaire) as expansive as the one produced for the purposes of this study, a number of design and layout considerations come into play. Chief among these considerations is the establishment of an appropriate common frame of reference while ensuring that the instrument remains respondent-friendly and easy to complete.

To address the aforementioned consideration, two strategies were employed in designing the layout of the survey instrument. The first strategy relates to the conceptual partitioning (i.e. segmentation) of the questionnaire in appropriately distinct thematic sections, while the second relates to the positioning of key question items in a way that facilitates cognitive retrieval.

A survey questionnaire's respondents often preview the instrument and particularly pay attention to the way that the various question items are positioned within it in order to interpret how items relate to each other conceptually (Ostrom et al., 1992). As such, it is posited that the establishment of clear thematic sections, each headlined by a description of the overall conceptual domain of interest, is a useful layout strategy that can further facilitate the establishment of appropriate frames of reference. Given the foregoing point, a succinct content analysis of the survey's question items and subject matter (without regarding the items' theoretical framework membership) led to the partitioning of the questionnaire in seven discrete thematic sections. Subsequently, the survey's question-items were distributed among the various sections according to their cohesion with each section's identified subject matter. The thematic sections that were formed included:

1. Company background
2. Managing engine maintenance
3. Engine maintenance characteristics
4. Procuring engine maintenance (buyer's side)
5. Procuring engine maintenance (supplier's side)
6. Relations with suppliers
7. Various organizational issues

The second strategy that was utilized in structuring the questionnaire's final layout revolved around the sequencing of the question items within the respective thematic sections. According to Tourangeau et al. (2000) and Weijters et al. (2009), when respondents face a set of question items, they generate a specific strategy in order to retrieve relevant information from memory-based belief samples. Given the assumption of cognitive demand reduction, when similar question items are identified in close proximity to each other, respondents are more likely to draw information for all of the similar items from the belief sample that was originally retrieved to tackle the question-set's first item (Tourangeau et al., 2000). While this tendency is identified by Weijters et al. (2009) as a potentially information-reducing situation in the case of paired items measuring the same construct, it is posited here that the same tendency could prove beneficial in other contexts. What is argued then is that the tendency to draw from a singular belief sample could be beneficial when similar (or in this case similarly phrased) question items attempt to measure related yet conceptually distinct constructs.

An example of this kind of strategy is the clustering of the different asset specificity question-items in successive order. In the case of a principal's asset specificity then, the respondent would more easily retain the contextual setting of the associated questions as say "Things that need to change so that we can switch suppliers". Another example would be the two questions related with technological uncertainty. As such, the items dealing with the unpredictability and speed of technological developments in a given setting are similarly clustered together. Given this premise, a number of such closely associated question items were clustered within the survey instrument's respective thematic questions. The final layout of the survey instrument is provided in Appendix A.3.

8.4.2 Survey instrument construction and delivery requirements

Given the study's variance-based approach and elected industrial context for the collection of empirical data, a number of requirements regarding the survey instrument's final construction and delivery come into play. With regard to the study's elected industrial context (i.e. the deep-sea marine shipping industry) such requirements include, in no particular order: the need for enhanced survey instrument transmissibility, the need for enhanced security (safety of potentially privileged information), the need for increased survey response flexibility and consequently also the need for enhanced item response amenability. Finally, the study's variance-based approach posed the requirement for fine-grained alternative response formats (Mathieson and Doane, 2005; Treiblmaier and Filzmoser, 2009).

The need for enhanced survey instrument transmissibility is a requirement that refers to the ability of conveying and delivering the survey instrument to the study's respondents over large distances. The issue arises from the peculiarity of the elected empirical context where the various respondents are found scattered throughout the world according to the home-base of the respective deep-sea marine shipping firm that they belong to.

The need for enhanced security, or more specifically the need for enhanced item response content security, refers to the need to maintain the possibly privileged access availability status of information included in a firm's responses. While the study put on every effort to make sure that the item response content of each individual shipping firm is sufficiently aggregated so as not to warrant a privileged access status, the issue is nevertheless acknowledged and addressed in order to ensure good-faith between the study and the survey's respondents.

The need for increased survey response flexibility refers to the need to bestow upon the respondents the ability to complete the survey instrument at the time and in the manner of their choosing. In recognizing that a high-level technical or executive marine shipping firm manager's responsibilities set limits to the availability of consecutive survey response time, the instrument's construction and delivery needs to allow the respondents to pause and resume the completion process as many times as needed.

The need for enhanced item response amenability refers to the need to allow respondents to easily review and change or amend previous responses. This issue is principally considered a consequence of the need for increased survey response flexibility in the sense that multiple survey completion sessions may warrant the review and revision of previously completed question items.

Finally, the requirement for fine-grained alternative response formats relates to the study's treatment of response data as continuous interval variables entered in parametric statistical analysis. As such, the finer-grained the alternative response formats (i.e. the more variability allowed in the responses) the better suited the response data is to statistical manipulation.

8.4.3 A web-based instrument construction and delivery platform

Given the requirements articulated in the previous section, the study puts forth that the best vehicle for the survey instrument's implementation and subsequent delivery is that of an electronic internet browser-based survey research platform. While a number of the aforementioned requirements are also sufficiently satisfied through other electronic media that are not internet browser-based (e.g. an electronic document/form of PDF format), it is recognized that browser-based platforms satisfy the study's requirements in a more comprehensive way. The key advantages offered by the selected platform relate to the enhanced security and fine-grained alternative response format requirements.

The internet-browser based survey research platform utilized in this study is the Qualtrics Research Suite (Qualtrics Labs, 2012). Funding for the use of the survey system was kindly provided by Warwick Business School's Doctoral Programme Office. The particular survey research platform offers enhanced security on the researcher's side through restricted access to the study's construction, delivery and data collection resources (i.e. software control panels)

(Figure 8-3). From a focal marine shipping firm's perspective, enhanced security is offered by ensuring that access to each firm's individual survey form (and thus, responses) is possible only through the use of a unique and encrypted Uniform Resource Locator (URL) link. An example of such an encrypted URL link is provided below:

https://wbs.qualtrics.com/SE/?SID=SV_6g9s2oJeQgzRvnu&Q_R=R_dhH2QqAsvtzRcf&Q_R_DEL=1

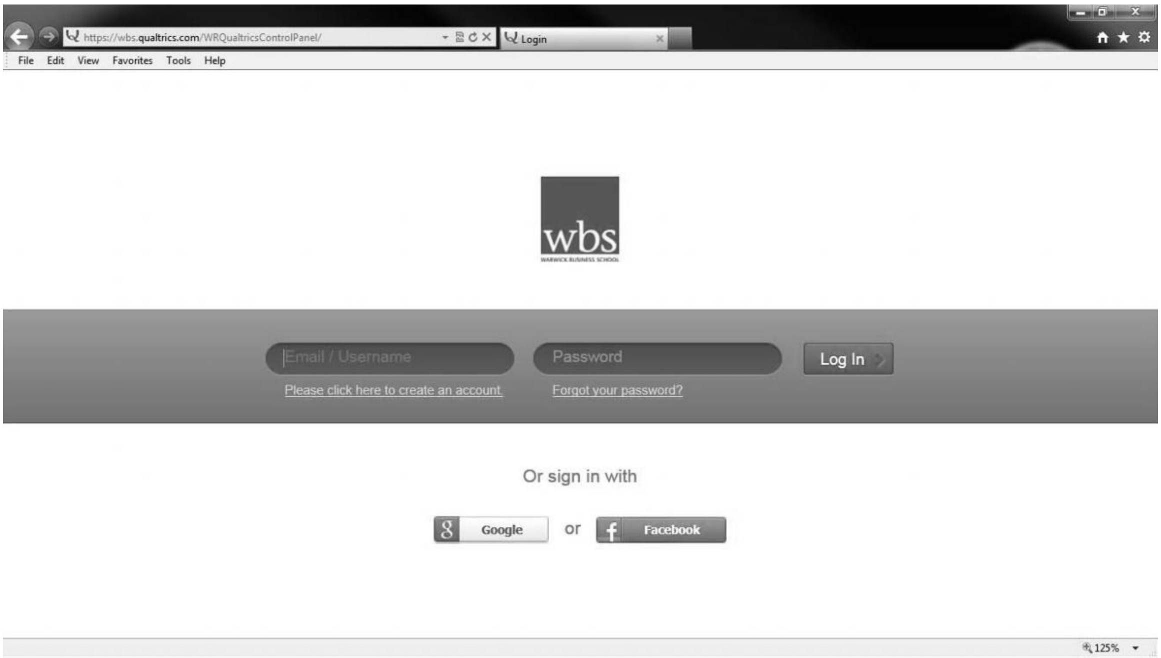


Figure 8-3. Illustration of the Qualtrics Research Suite control panel's restricted access

Fine-grained alternative response formats are provided by the particular survey research platform through the availability of continuous slider-type responses for use in a question item's response section. Figures 8-4 and 8-5 illustrate the use of slider-type response formats by presenting a random question item's initial and hypothetical final state (after completion) respectively. The continuous scales utilized in the study range from a minimum of 0.00 to a maximum of 7.00 with 0.01 intervals being the unit of incremental change possible (values not observable by respondents).

How difficult is it to find and recruit experienced professionals for each activity?

	Not at all		Slightly Difficult		Quite Difficult		Extremely Difficult
	0	1	2	3	4	5	6 7
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

Figure 8-4. Initial state of a fine-grained alternative response format

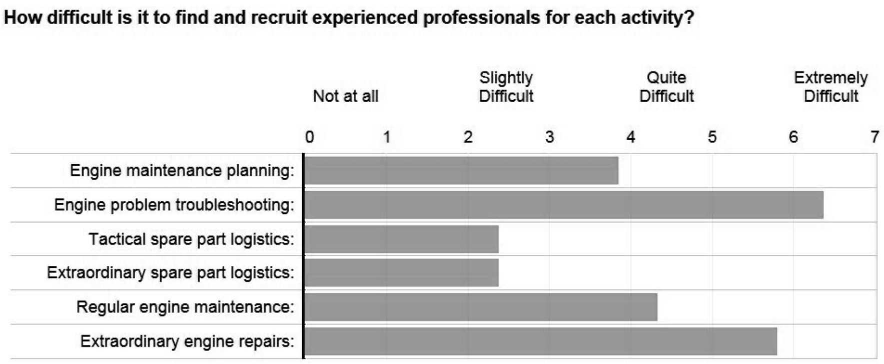


Figure 8-5. Hypothetical final state of a fine-grained alternative response format

Given the above, the study's survey data collection instrument was constructed in its entirety in HyperText Markup Language (HTML) with Cascading Style Sheets (CSS) enhanced through JavaScript code snippets. A number of automation and coding facilities provided by the survey research platform rendered the survey construction process a more intuitive and less tedious affair. Figure 8-6 provides an illustration of the survey instrument's construction process.

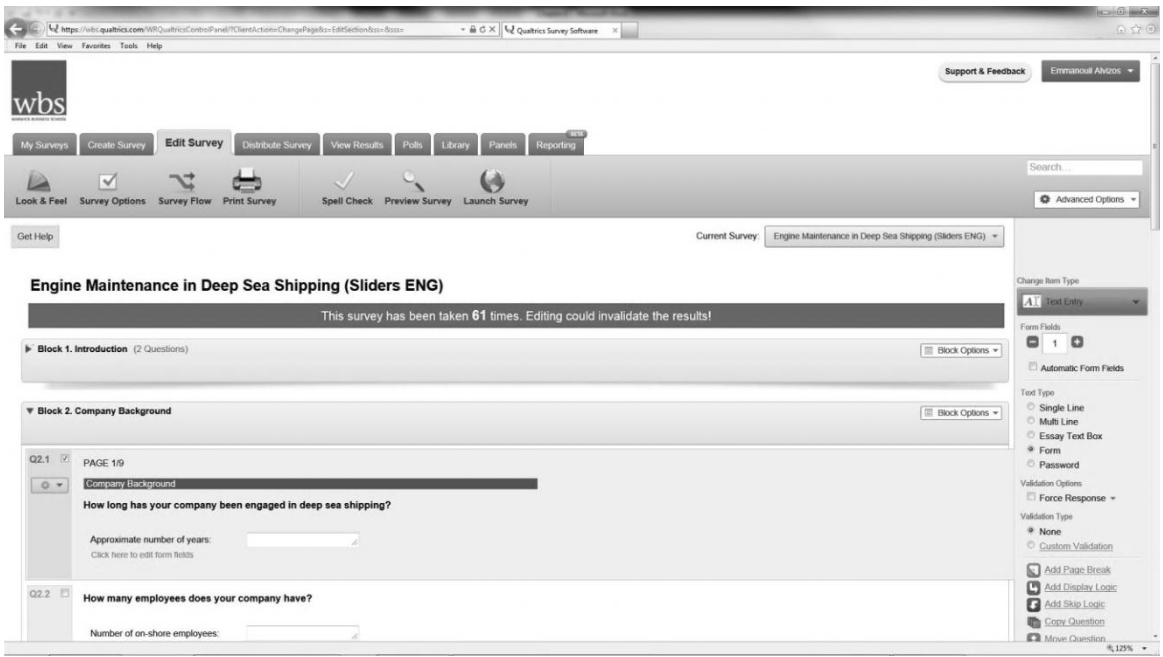


Figure 8-6. Illustration of the survey instrument's construction process

Apart from the above mentioned advantages, the elected web-based survey platform allows a host of further capabilities that facilitate the coordination and administration of the study's empirical data collection process. These capabilities are offered through the software's integrated survey distribution suite. They include the ability to collate and organize the survey's respondent details and contact information while further offering the ability to track all e-mail correspondence conducted in the cadre of the survey's administration (through a fully functional e-mailing system). Figure 8-7 provides an illustration of the survey platform's distribution suite.

Finally, the particular survey research platform offers increased functionality with regard to the retrieval and exploitation of the data collected. As such, the collected data may be retrieved in a

Comma Separated Values (CSV) format (for import to numerical spreadsheet software, e.g. Microsoft Excel), a Statistical Package for the Social Sciences (SPSS) sav data file format, a fixed-field-length format (as a .txt file), in eXtensible Markup Language (XML) format and, finally, a HyperText Markup Language (HTML) format. Figure 8-8 illustrates the different data retrieval options available. Figure 8-9 provides an illustration of survey data retrieval in HTML format as an extensive singular table (note the two decimal point response levels provided by the survey's continuous rating scales).

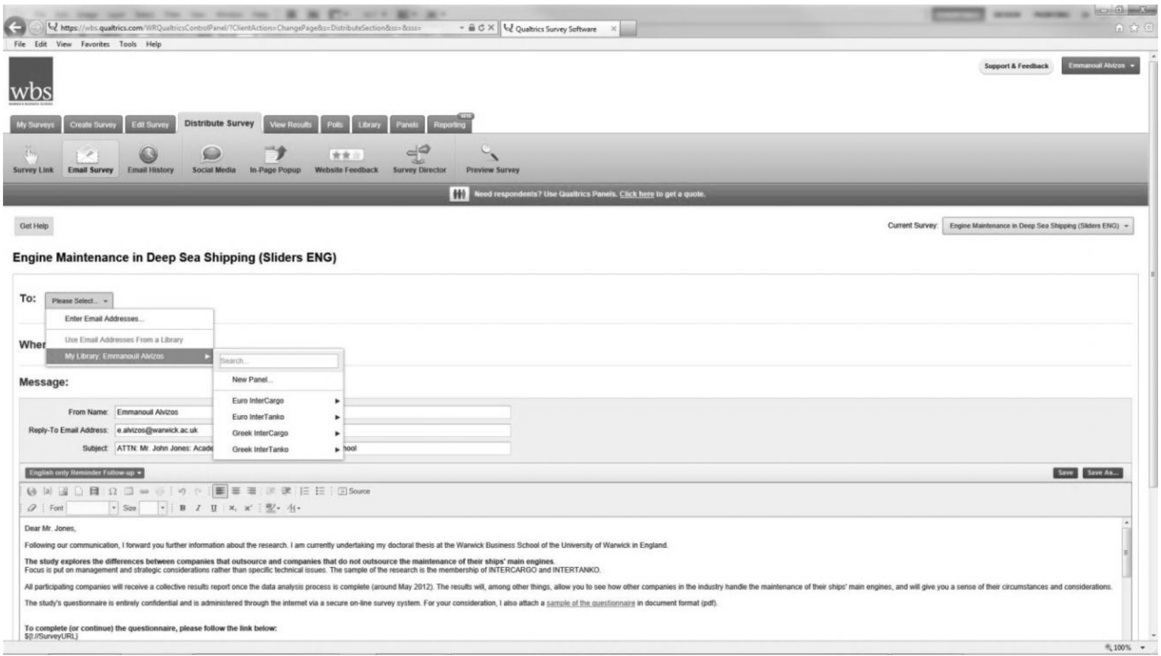


Figure 8-7. Illustration of the survey instrument's distribution process

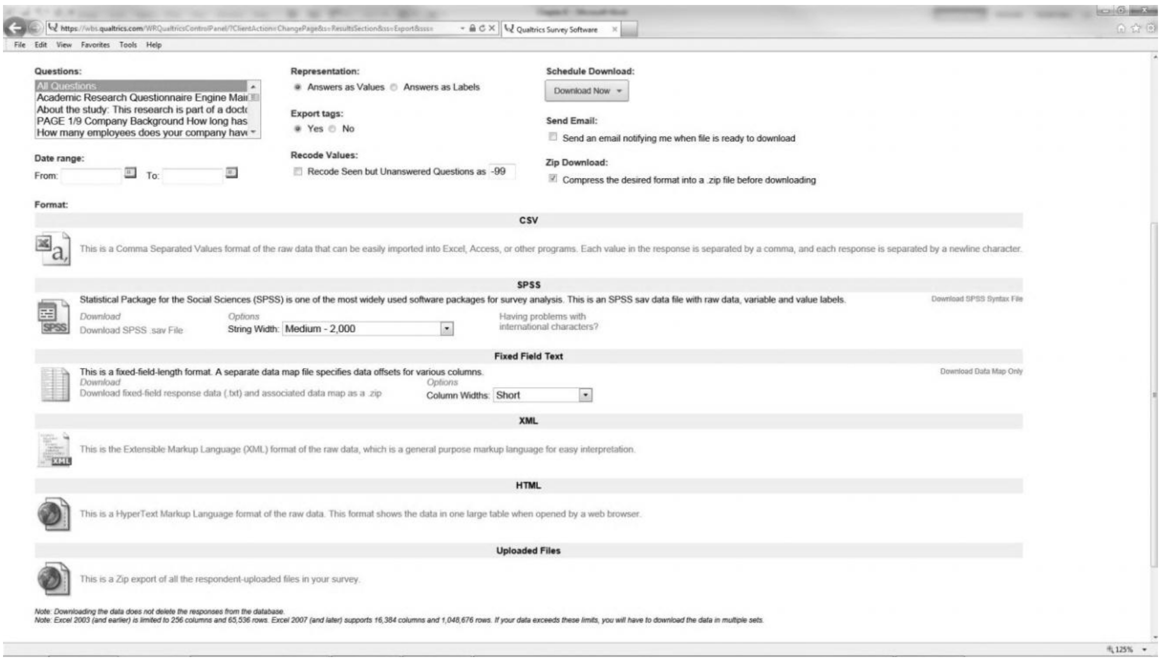


Figure 8-8. Illustration of the survey instrument's data retrieval process

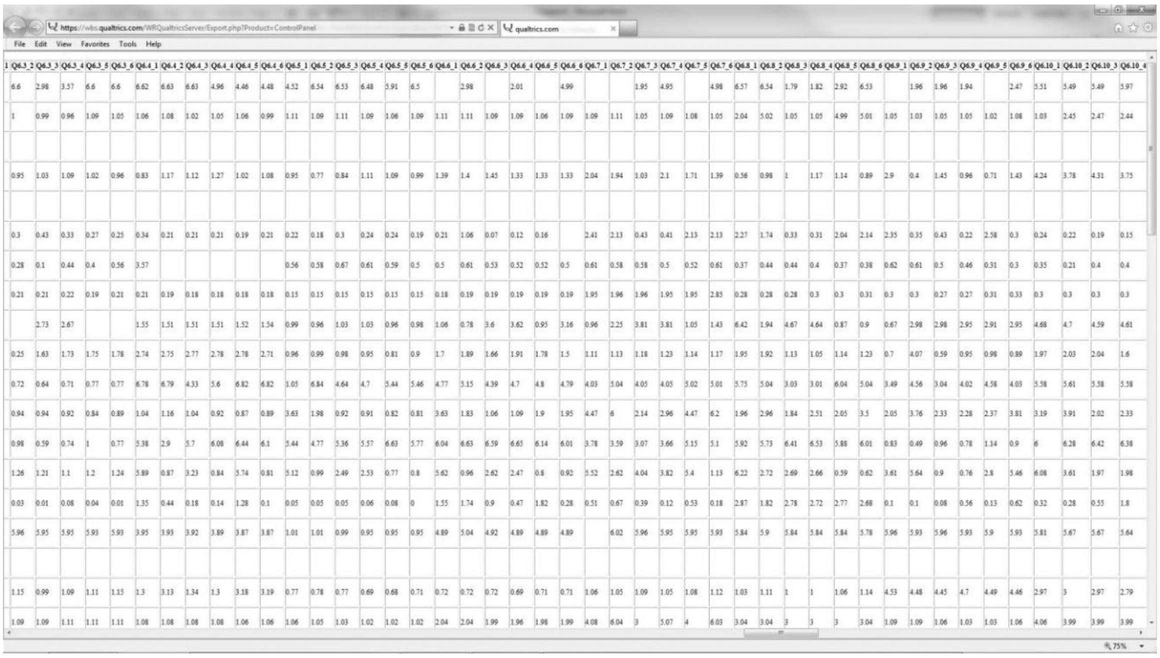


Figure 8-9. Illustration of the survey's collected data in HTML format

8.5 Survey instrument administration

This section reports on the process of the survey instrument's administration. Primarily, the section reports on the preliminary steps taken in preparation of contacting the focal marine shipping firms. Secondly, the section outlines the algorithmic sequence of actions taken in the administration of the questionnaire while simultaneously discussing a number of issues that and pitfalls that . The section concludes by reporting some noteworthy statistics associated with the data collection process.

8.5.1 Some preliminary steps

As reported previously in the methodological foundation chapter of the thesis, the study's sampling frame, from which the cases under consideration are drawn, consists of the combined membership lists of INTERCARGO and INTERTANKO (a total of 241 firms). Furthermore, given the relatively manageable size of the sampling frame no particular probability-based sampling strategy is employed. Instead, the study inquires all members of the sampling frame. In preparation of the actual inquiry process, a number of preliminary steps were taken. These included the listing of the member firms by country of origin, the a priori collection of contact information, the a priory selection of an appropriate informant candidate and the preparation of an appropriate survey cover letter.

The listing of INTERCARGO and INTERTANKO members by country of origin aimed primarily at the better coordination of the firm contact and participation elicitation process. To ensure the best possible survey response rate, it was early-on decided that telephone conversations would be an indispensable part of the survey administration stage. At the same time, though, the associations' members hail from a variety of geographical regions within different time-zones and a multitude of different countries with varying office-hours. This variability in time-zones and country-specific office hours was also early-on identified as a significant practical obstacle in the study's efforts to contact the relevant firms by phone and elicit their participation. Nevertheless, the hardship is lessened if firms operating in the same or closely neighbouring time-zones and relevant countries are contacted in close sequence. As such, the clustering of marine shipping firms according to the country in which their headquarters are located can only be deemed as a prudent practice.

The a priori collection of contact information included the record-keeping of the various shipping firms' reception telephone numbers and general inquiry e-mail addresses. This step was taken in anticipation to the firm contact process to ensure that the firms were indeed accessible. The relevant information was principally collected through the membership lists of INTERCARGO and INTERTANKO and was further cross-referenced and updated through each firm's corporate website (if available).

The a priori selection of an appropriate informant candidate included the initial identification of individuals (one from each shipping firm) that could meaningfully inform the study by completing the survey questionnaire. While the study's informant requirements are described in more detail in the thesis's methodological foundation chapter, it is briefly reported here that candidates for the informant role included the firm's Chief Executive Officer (if associated also with technical matters), the Chief Technical or Chief Operations Officer, the Fleet Manager, the Technical Manager and the Chief Superintendent Engineer. Informant candidates were considered in hierarchical succession and appropriate individuals were selected either through consultations with each firm's organization chart (usually available in each firm's corporate website) or through information provided in specialized resources such as the 'Greek-Cypriot Maritime Database' (MIS, 2012). This step is identified as valuable resource in overcoming the initial contact obstacle posed by a shipping firm's reception operators.

Finally, the preparation of an appropriate survey cover letter was the final preliminary step before the firm contact process. As telephone conversations are fleeting and only meant to better engage marine shipping firm executives while establishing the researcher's credibility, an enduring cover letter is a sine qua non for survey research programmes. Formulated as an e-mail following a preceding telephone conversation, the cover letter articulates the study's purposes, participation process, expected results and benefits for the participating firms as well as the survey's completion deadline. Additionally, the cover letter would include a PDF document version of the questionnaire designated only for preview purposes. Finally, the cover letter concludes with the researcher's credentials and contact information along with an acknowledgment of appreciation for the informant's time spent in learning about the research. A sample of the study's cover letter is provided in Appendix A.4.

8.5.2 Firm contact and survey administration particulars

Having reported all of the preliminary steps conducted in preparation to the study's empirical data collection, this section focuses on the actual firm contact and survey administration process. The algorithmic sequence in which firm contact and survey administration occurred in each marine shipping firm's case included an initial telephone conversation, the confirmation of the survey respondent (i.e. each firm's informant), the transmission of the survey's cover letter and unique access link, the provision of support during survey completion and finally, the acknowledgment of a completed survey's reception.

The initial telephone conversations were utilized to establish the credibility of the research programme and elicit each firm's participation to the study. In having an a priori identified candidate informant in each firm's case, the telephone calls were directed to those individuals. An introduction and brief explanation of the survey research then prompted whether a shipping firm wished to participate in the study or not. Once a positive response to the call to participate was received, the conversation veered towards the confirmation of the survey respondent.

The confirmation of the survey respondent aimed at the identification of the particular individual that would ultimately be responsible for the survey's completion in each particular marine shipping firm. The confirmation process included the record keeping of the respondent's name, titular position and specific contact information (e.g. personalized corporate e-mail address and office telephone number). Usually, the final survey respondent would be the same as the a priori selected informant candidate. In other cases, the survey completion task would be handed down to a lower administrative position, but never lower than that of a Chief Superintendent Engineer. The most common titular position responding to the survey was that of a firm's Technical Manager.

Following the confirmation of the survey's respondent, transmission of the survey's cover letter and unique access link was performed through e-mail correspondence. The relevant e-mail was customized per focal marine shipping firm (in including the encrypted URL with which access to the particular firm's questionnaire was achieved) and along with the on-line survey instrument's introduction provided all of the information necessary to initiate the survey completion process. At this point, it should be underlined that a verbal verification of the e-mail correspondence's good reception is urgently advised in similar survey-based studies. More often than not, the case would be that the original e-mail transmission had failed to reach its recipients for various reasons (other than incorrectly input addresses). These principally included corporate firewalls rejecting technically anonymous e-mails originating from the survey platform's mailing system, e-mail 'spam' filters directing the correspondence in 'junk' folders as well as text encoding incompatibilities (between sending and receiving ends) that could render e-mails illegible. Solutions were found in each and every case, though, only after the acknowledgement of a problem.

Further support to the survey's respondents was provided in a number of ways. First and foremost, the survey's respondents were handed the researcher's full contact information with the encouragement to contact in the case of conceptual or technical difficulties. The respondents, perhaps surprisingly, given the value of their time and busy schedules, would more than seldom opt to contact the researcher with various inquiries. Alternatively, discreet encouragement was further provided by reminder phone calls inquiring a respondent whether everything was in order and well-understood. As such, the provision of support during the survey's completion is identified as one of the more valuable steps in the administration process.

Finally, the acknowledgement of a completed survey's reception (detected by the on-line survey research platform) acted as a thanking note aimed at the respondents for sacrificing valuable business (and in some cases, even personal) time in completing the study's questionnaire.

In all cases, marine shipping firms were given a two month deadline to complete the questionnaire with reminder phone calls being performed at 15 to 20 day intervals (approximately three reminder calls per shipping firm. Although the majority of respondents completed the survey within a 5 to 10 day period there were cases were unforeseen obligations (a common theme in the marine shipping industry) held up the completion process for longer times (though never more than the given deadline).

The overall process described above for the entirety of the study's sampling frame lasted for nearly six months and yielded a 24.8% response rate (60 completed corporate responses). Telling of the effort put in the data collection process is, perhaps, the fact that the researcher's phone records indicated a total of 1,127 phone calls performed for the needs of this research with a total running time of approximately 4.6 days.

Chapter 9

Data analysis and empirical results

9.1 Introduction

This chapter focuses on the analysis procedures applied on the study's empirical data and further reports their respective outcome results. Specifically, the chapter initiates with a report of the data preparation treatments and practices used to derive appropriately manipulable datasets. Subsequently, emphasis is put on the specific statistical analysis techniques utilized in the exploration of the study's propositions.

9.2 Data preparation

This section focuses on the process followed in order to prepare the survey's empirical data for statistical analysis. The section describes the relevant processes from the point of raw data retrieval up to the point of data input in a statistical analysis software package for further examination.

9.2.1 Retrieving and collating the raw data

The study's survey responses of marine shipping firms are originally stored in the Qualtrics Survey Research Suite's on-line databases. Furthermore, due to practical considerations relating with the management of the data collection process, the various firm's responses were originally clustered in different firm group data packs (e.g. a data pack containing responses of EU-based INTERCARGO member firms, another with their non-EU-based counterparts, etc.). As such, the data initially needed to be retrieved and appropriately collated into a comprehensive listing of marine shipping firm survey responses.

The data retrieval method utilized to extract the survey responses from the survey research suite's on-line databases took advantage of the Comma Separated Values (CSV) format. As such, the data was extracted through a number of csv type files, each containing a different firm group data pack. These raw data files were then stored locally for further processing. Afterwards, each data file's contents were accessed through a spreadsheet software application (in this case Microsoft Excel, 2010) and then stored in a series of spreadsheet format files (i.e. xlsx worksheets) that contained the data in rows and columns of alphanumeric manipulable cells. Each spreadsheet would then contain a marine shipping firm's entire survey response within a specific row with the different columns designating the survey's various question items.

Finally, the various spreadsheets' contents, that still represented varying group storage data packs, were collated (through basic copy-paste procedures) in one master spreadsheet (and thus, dataset) containing the responses of all of the shipping firms that participated, even in an incomplete way, in the survey.

9.2.2 Removing incomplete responses and organizing the dataset

Afterwards, focus was put in removing the responses of shipping firms that participated in the survey in an incomplete way. The removal process would initially consider responses that never made it past the survey's introductory page and responses where the dependent variable questions were not answered (a validation-check in the questionnaire's design would disallow further completion if these key questions remained unanswered). This removal process resulted in 70 firm responses remaining in the dataset. Finally, 10 more responses were excluded on the basis that the corresponding shipping firms had not formally acknowledged their responses' submission (either verbally or through the on-line survey system). As such, 60 complete firm responses collectively formed the study’s empirical dataset.

Subsequently, in the interest of traceability, the complete responses were arranged within the dataset in a two-fold manner. Primarily, firm responses were arranged according to the industry association in which the corresponding firms were members. As such, INTERCARGO member firm responses were listed first, then to be followed by INTERTANKO member firm responses. Secondly, within the two industry association pseudo-groups, the responses were arranged alphabetically (according to company name). The aforementioned listing arrangement was performed so that each firm’s response could easily be cross-referenced against the original raw data pending further manipulations of the dataset in subsequent analysis stages.

9.2.3 Delineating and organizing variable identity headers

Having arranged the dataset’s firm responses in the aforementioned manner, focus was then put on delineating the content of the dataset’s columns. This was necessary because up to this point each spreadsheet column (and thus, its associated variable values) was principally identified through a numbering system that was based on the survey research suit’s internal workings. As such, the existing numbering scheme followed the sequence in which items appeared on the on-line version of the survey instrument regardless of whether the items were in fact questions, expositional text or even images. Figure 9-1 provides an illustration of this original sequence-driven variable identification scheme. Consequently, an alternative, more content-driven, approach to identify each of the columns was deemed necessary.

DE	DF	DG	DH	DI	DJ	DK	DL	DM	DN	DO	DP	DQ	DR	DS
Q3.5_1_1	Q3.5_1_2	Q3.5_1_3	Q3.5_1_4	Q3.5_1_5	Q3.5_2_1	Q3.5_2_2	Q3.5_2_3	Q3.5_2_4	Q3.5_2_5	Q3.5_3_1	Q3.5_3_2	Q3.5_3_3	Q3.5_3_4	Q3.5_3_5
Who carri	Who carri	Who carri	Who carri	Who carri	Who carri	Who carri	Who carri	Who carri	Who carri	Who carri	Who carri	Who carri	Who carri	Who carri
100	0	0	0	0	100	0	0	0	0	100	0	0	0	0
100	0	0	0	0	100	0	0	0	0	90	0	0	0	10
100	0	0	0	0	100	0	0	0	0	100	0	0	0	0
90	0	0	0	10	90	0	0	0	10	90	0	0	0	10
100	0	0	0	0	100	0	0	0	0	100	0	0	0	0
100	0	0	0	0	100	0	0	0	0	100	0	0	0	0
0	0	65	0	35	0	0	75	0	25	0	0	65	0	35
100	0	0	0	0	100	0	0	0	0	100	0	0	0	0
100	0	0	0	0	100	0	0	0	0	95	0	5	0	0
70	0	0	0	30	50	0	0	0	50	70	0	0	0	30
100	0	0	0	0	100	0	0	0	0	100	0	0	0	0
100	0	0	0	0	100	0	0	0	0	100	0	0	0	0
20	0	20	0	60	60	0	20	0	20	60	0	20	0	20
80	0	20	0	0	100	0	0	0	0	80	0	20	0	0
80	0	0	0	20	100	0	0	0	0	80	0	0	0	20
60	0	20	0	20	0	0	0	0	100	50	0	0	0	50
100	0	0	0	0	100	0	0	0	0	100	0	0	0	0
100	0	0	0	0	100	0	0	0	0	100	0	0	0	0
100	0	0	0	0	100	0	0	0	0	100	0	0	0	0
60	0	40	0	0	60	0	40	0	0	40	0	60	0	0
100	0	0	0	0	100	0	0	0	0	100	0	0	0	0
95	0	5	0	0	100	0	0	0	0	95	0	5	0	0
70	0	30	0	0	90	0	10	0	0	30	0	70	0	0
100	0	0	0	0	100	0	0	0	0	100	0	0	0	0
30	0	0	0	70	30	0	0	0	70	40	0	0	0	60

Figure 9-1. Illustration of instrument sequence-driven variable identification scheme

The variable identification process initially included the graphical grouping of all relevantly associated variable values through table borders (i.e. the grouping of data points belonging to the same question item). For example, all of the data points portrayed in Figure 9-1 belong to the question item referring to the responsibility outsourcing of non-planned maintenance activities. Ergo, an overarching header recognizing them as such was developed in the form of “Who is responsible for the Non-Planned engine maintenance function” seen in Figure 9-2. Similarly, respective sub-headers were developed to identify which maintenance activities were considered in each of the overall table’s sections (in the portrayed example: Engine problem troubleshooting, extraordinary spare part logistics and extraordinary engine repairs). Finally, the alternative responses available in each maintenance activity's case were identified through an even lower-order set of headings (seen here to include the abbreviated alternatives of: the focal company, a subsidiary/sister firm, an engine designer/manufacturer, a collaborating shipyard and third-party associates). Similar variable identification patterns were developed throughout the rest of the dataset.

DP	DQ	DR	DS	DT	DU	DV	DW	DX	DY	DZ	EA	EB	EC	ED
D04														
S1.5 Who is responsible for the Non-Planned engine maintenance function														
Engine problem troubleshooting					Extraordinary spare part logistics					Extraordinary engine repairs				
company	subsidiary	designer	shipyard	thirdparty	company	subsidiary	designer	shipyard	thirdparty	company	subsidiary	designer	shipyard	thirdparty
Q3.5_1_1	Q3.5_1_2	Q3.5_1_3	Q3.5_1_4	Q3.5_1_5	Q3.5_2_1	Q3.5_2_2	Q3.5_2_3	Q3.5_2_4	Q3.5_2_5	Q3.5_3_1	Q3.5_3_2	Q3.5_3_3	Q3.5_3_4	Q3.5_3_5
Who carri	Who carri	Who carri	Who carri	Who carri	Who carri	Who carri	Who carri	Who carri	Who carri	Who carri	Who carri	Who carri	Who carri	Who carri
100	0	0	0	0	100	0	0	0	0	100	0	0	0	0
100	0	0	0	0	100	0	0	0	0	90	0	0	0	10
100	0	0	0	0	100	0	0	0	0	100	0	0	0	0
100	0	0	0	0	100	0	0	0	0	100	0	0	0	0
90	0	0	0	10	90	0	0	0	10	90	0	0	0	10
100	0	0	0	0	100	0	0	0	0	100	0	0	0	0
100	0	0	0	0	100	0	0	0	0	100	0	0	0	0
0	0	65	0	35	0	0	75	0	25	0	0	65	0	35
100	0	0	0	0	100	0	0	0	0	100	0	0	0	0
100	0	0	0	0	100	0	0	0	0	95	0	5	0	0
70	0	0	0	30	50	0	0	0	50	70	0	0	0	30
100	0	0	0	0	100	0	0	0	0	100	0	0	0	0
100	0	0	0	0	100	0	0	0	0	100	0	0	0	0
20	0	20	0	60	60	0	20	0	20	60	0	20	0	20
80	0	20	0	0	100	0	0	0	0	80	0	20	0	0
80	0	0	0	20	100	0	0	0	0	80	0	0	0	20
60	0	20	0	20	0	0	0	0	100	50	0	0	0	50
100	0	0	0	0	100	0	0	0	0	100	0	0	0	0

Figure 9-2. Illustration of content-driven variable identification scheme

Having appropriately identified each variable's associated data points and having described their respective content through variable-order headings, a final step taken during this phase included the rearrangement of the dataset's columns on a conceptual basis. Even though the columns' content was sufficiently characterized, their ordering was still relying on the survey research suit's internal workings. Thus, to render further conceptual cohesion to the dataset pending the forthcoming data analysis, the various interrelated column groups were rearranged in a sequence that more closely followed the study's exploration of the various considerations included in each of the strategic perspectives. For example, column groups referring to variables associated with efficiency-based considerations were put together and ordered according to the study's exposition sequence. Congruently, column groups referring to dependency, competence and identity-based considerations were similarly grouped together and ordered accordingly. Separate, yet similar, arrangement patterns were followed for the study's dependent and control variables.

Finally, it is worthwhile to note that a number of basic calculations are performed at this stage of the data preparation process. For example, the estimation of the overall outsourcing level of the focal maintenance activities is performed here. The variable denoting the level of outsourcing per focal maintenance activity is considered to be formed by the sum of the activity's performance outsourcing and responsibility outsourcing levels. As such, the individual performance and responsibility outsourcing levels of each firm's maintenance activities (operationalized as percentages) are summed here. To conduct such operations, additional column sequences of a more auxiliary nature are introduced in the dataset accompanied by appropriate heading descriptions. For instance, in the case of the focal maintenance activities' outsourcing levels, three such column sequences are generated to contain the calculation of each activity's performance, responsibility and overall outsourcing levels (Figure 9-3).

HN	HO	HP	HQ	HR	HS	HT	HU	HV	HW	HX	HY	HZ	IA	IB	IC	ID	IE
Performance Outsourcing per activity						Responsibility Outsourcing per activity						Outsourcing per activity					
Performance Only						Responsibility Only						Performance & Responsibility combined					
D01			D02			D03			D04			D01-D03 std			D02-D04 std		
Calculated by subtracting the sum of percentages perfomed by the company and/or subsidiaries from 100. Max:100						Calculated by subtracting the sum of percentages responsible by the company and/or subsidiaries from 100. Max:100						Calculated by standardizing the sum of activity performence and responsibility given a max of 200 points to 100					
Planned Maintenance			Non-Planned Maintenance			Planned Maintenance			Non-Planned Maintenance			Planned Maintenance			Non-Planned Maintenance		
PlanMaint	TactSpare	RegMaint	Trblshoot	ExtraSpare	ExtraRepai	PlanMaint	TactSpare	RegMaint	Trblshoot	ExtraSpare	ExtraRepai	PlanMaint	TactSpare	RegMaint	Trblshoot	ExtraSpare	ExtraRepai
0	0	10	0	0	20	0	0	0	0	0	0	0	0	5	0	0	10
10	0	0	0	0	10	0	0	0	0	0	10	5	0	0	0	0	10
0	0	20	20	0	40	0	0	0	0	0	0	0	0	10	10	0	20
0	5	0	50	5	100	0	5	0	0	0	0	0	5	0	25	2.5	50
10	100	10	10	10	20	10	50	10	10	10	10	10	75	10	10	10	15
20	100	10	20	0	10	0	0	0	0	0	0	10	50	5	10	0	5
0	0	20	10	0	20	0	0	0	0	0	0	0	0	10	5	0	10
35	0	25	100	100	100	50	50	50	100	100	100	42.5	25	37.5	100	100	100
0	0	10	0	0	10	0	0	0	0	0	0	0	0	5	0	0	5
0	0	10	0	0	10	0	0	10	0	0	5	0	0	10	0	0	7.5
0	50	70	30	50	30	0	50	70	30	50	30	0	50	70	30	50	30
0	0	10	20	0	20	0	0	0	0	0	0	0	0	5	10	0	10
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	20	0	80	40	40	0	0	0	80	40	40	15	10	0	80	40	40
0	0	0	20	0	0	0	0	0	20	0	20	0	0	0	20	0	10
0	0	0	20	0	20	0	0	0	20	0	20	0	0	0	20	0	20

Figure 9-3. Auxiliary column sequences for the calculation of activity outsourcing levels

9.2.4 Aggregating the dataset to the maintenance activity level

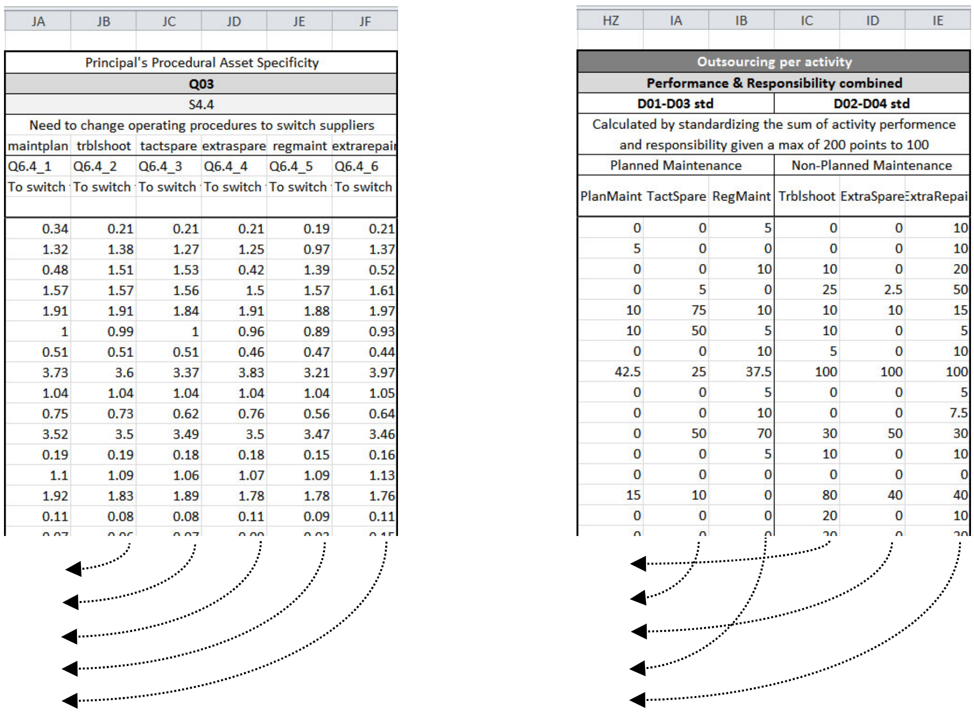
So far, in discussing the various data preparation phases, it was evident that the dataset's rows refer to individual shipping firm responses. In other words, each row up to now signified the case of an individual marine shipping firm. The study's unit of analysis, however, is the maintenance activity and not the marine shipping firm. As such, an essential step in the preparation of the data for analysis is the dataset's aggregation from the firm level to the maintenance activity level. The dataset, then, must be transformed from the consideration of individual firm cases to the consideration of individual maintenance activity cases. Given that each firm has provided responses with regard to six focal maintenance activities, all of the relevant information is already present. Nevertheless, the information is dispersed in multiple sequences of six 60 row-long columns scattered throughout the dataset. Figure 9-4 illustrates such a six-columned sequence containing information with regard to the principals' procedural asset.

JA	JB	JC	JD	JE	JF
Principal's Procedural Asset Specificity					
Q03					
S4.4					
Need to change operating procedures to switch suppliers					
maintplan	trblshoot	tactspare	extraspare	regmaint	extrarepair
Q6.4_1	Q6.4_2	Q6.4_3	Q6.4_4	Q6.4_5	Q6.4_6
To switch	To switch	To switch	To switch	To switch	To switch
0.34	0.21	0.21	0.21	0.19	0.21
1.32	1.38	1.27	1.25	0.97	1.37
0.48	1.51	1.53	0.42	1.39	0.52
1.57	1.57	1.56	1.5	1.57	1.61
1.91	1.91	1.84	1.91	1.88	1.97
1	0.99	1	0.96	0.89	0.93
0.51	0.51	0.51	0.46	0.47	0.44
3.73	3.6	3.37	3.83	3.21	3.97
1.04	1.04	1.04	1.04	1.04	1.05
0.75	0.73	0.62	0.76	0.56	0.64
3.52	3.5	3.49	3.5	3.47	3.46
0.19	0.19	0.18	0.18	0.15	0.16
1.1	1.09	1.06	1.07	1.09	1.13
1.92	1.83	1.89	1.78	1.78	1.76
0.11	0.08	0.08	0.11	0.09	0.11

Figure 9-4. Six-columned sequence relating to Principals' procedural asset specificity

Given the above, the aggregation of the dataset to the maintenance activity level is performed by collating each individual variable's six 60 row-long columns one under the other through a series of copy-paste operations on the dataset's spreadsheet. As such, a 360 case-long (i.e. row-long) dataset is structured with each consecutive 60 row section of it representing information with regard to a particular maintenance activity. At this point, it should further be noted that due caution was attended to in maintaining the integrity of the various shipping firm responses. In other words, it was made sure that each of the 360 cases contained in the aggregated dataset presented absolute correspondence and consistency with the marine shipping firms' responses.

The need for caution is formidably illustrated once the aggregation of activity outsourcing levels (last six columns of Figure 9-3) is considered. Keen-eyed viewers will observe that in the dependent variable's case, the ordering sequence of the six focal maintenance activities in the non-aggregated dataset is different than that in the case of principals' asset specificity levels. The first holds planned and non-planned maintenance related activities grouped together while the second one does not. As the majority of variables follow the latter ordering sequence, the same one was utilized when structuring the aggregated dataset. Thus, due consideration was taken when aggregating variables that did not follow the same sequencing (as in activity level outsourcing) so that the dataset presented uniform consistency across cases. Figure 9-5 portrays the aggregation of the activity outsourcing dependent variable in contrast to the principal's procedural asset specificity variable.



JA	JB	JC	JD	JE	JF
Principal's Procedural Asset Specificity					
Q03					
S4.4					
Need to change operating procedures to switch suppliers					
maintplan	trblshoot	tactspare	extraspare	regmaint	extrarepai
Q6.4_1	Q6.4_2	Q6.4_3	Q6.4_4	Q6.4_5	Q6.4_6
To switch	To switch	To switch	To switch	To switch	To switch
0.34	0.21	0.21	0.21	0.19	0.21
1.32	1.38	1.27	1.25	0.97	1.37
0.48	1.51	1.53	0.42	1.39	0.52
1.57	1.57	1.56	1.5	1.57	1.61
1.91	1.91	1.84	1.91	1.88	1.97
1	0.99	1	0.96	0.89	0.93
0.51	0.51	0.51	0.46	0.47	0.44
3.73	3.6	3.37	3.83	3.21	3.97
1.04	1.04	1.04	1.04	1.04	1.05
0.75	0.73	0.62	0.76	0.56	0.64
3.52	3.5	3.49	3.5	3.47	3.46
0.19	0.19	0.18	0.18	0.15	0.16
1.1	1.09	1.06	1.07	1.09	1.13
1.92	1.83	1.89	1.78	1.78	1.76
0.11	0.08	0.08	0.11	0.09	0.11

HZ	IA	IB	IC	ID	IE
Outsourcing per activity					
Performance & Responsibility combined					
D01-D03 std			D02-D04 std		
Calculated by standardizing the sum of activity performence and responsibility given a max of 200 points to 100					
Planned Maintenance			Non-Planned Maintenance		
PlanMaint	TactSpare	RegMaint	Trblshoot	ExtraSpare	ExtraRepai
0	0	5	0	0	10
5	0	0	0	0	10
0	0	10	10	0	20
0	5	0	25	2.5	50
10	75	10	10	10	15
10	50	5	10	0	5
0	0	10	5	0	10
42.5	25	37.5	100	100	100
0	0	5	0	0	5
0	0	10	0	0	7.5
0	50	70	30	50	30
0	0	5	10	0	10
0	0	0	0	0	0
15	10	0	80	40	40
0	0	0	20	0	10

Figure 9-5. Illustration of dataset aggregation with different activity ordering structures

9.2.5 Variable reference codebook formation

Once the aggregation to the maintenance activity level is performed, the dataset is finally ready for the application of data analysis procedures. Nevertheless, again in the interest of traceability and proper management of the different variables in a data analysis software environment, it is deemed critical that an appropriate variable codebook is formed. A variable codebook can be identified as the listing of a variance-based study's variables of interest along with their unique data analysis software identification labels.

Many data analysis software packages do not accommodate for long explicit descriptions of the variables analysed, but rather depend on abbreviated strings of alphanumeric characters for their identification. In this study's case, the software package utilized in the analysis of data is the Statistical Package for the Social Sciences (SPSS) version 20.0 (IBM, 2011).

At this point, it should be noted that while Pallant (2007) provides a useful listing of rules applied when naming (and thus, identifying) variables in SPSS, the software package's variable labelling syntax rules seem to evolve with every iterative version release (e.g. in version 20.0 variable labels may contain any characters, including blanks, and can be up to 255 bytes long). In any case, in the interest of parsimony, the codebook developed for the purposes of this study adheres to the principles of keeping the variable labels concise yet sufficiently descriptive while not utilizing any blank or other unusual characters besides the underscore '_' character when denoting variable transformation operations.

Finally, it should be mentioned that due to specific considerations related with the data analysis strategy and methods used to explore the relationship between the different strategic considerations (independent variables) and the outsourcing of maintenance activities (dependent variable), two separate maintenance activity level datasets are constructed.

The first one contains all of the maintenance activity cases reported in the survey's questionnaire and is thus 360 cases long. This dataset is utilized for the performance of logistic regression analysis. In this particular method of data analysis the dependent variable (i.e. sourcing decision) is regarded as a binary outcome (in this case: activity outsourced to any degree / activity in-sourced) and the purpose is to explore whether the various considerations can meaningfully predict the outcome by classifying the dataset's maintenance activity cases in two groups: outsourced and non-outsourced. Thus, all maintenance activity cases are included in this dataset.

The second dataset contains only the cases of maintenance activities where the activity is outsourced to any degree (i.e. cases where an activity is fully in-sourced are excluded). This dataset is 195 cases long and is utilized in the performance of multiple linear regression analysis aimed at exploring the relationship between the various considerations and various levels of activity outsourcing levels. In this case, conceptual as well as dependent variable skewness considerations prohibit the inclusion of cases where an activity is fully in-sourced. In the interest of clarity and reporting accuracy, the variable names of both datasets are included in the study's variable reference codebook.

Table 9-1 presents the study's variable reference codebook with regard to efficiency-based considerations (in both datasets). Tables 9-2, 9-3 and 9-4 respectively do the same with the study's dependency, competence and identity-based considerations (similarly in both datasets). Table 9-5, finally, presents the variable label entrances with regard to the study's dependent and control variables.

Table 9-1. SPSS variable label codebook - Efficiency-based considerations

Conceptual designation of construct	Variable label (360 case dataset)	Variable label (195 case dataset)
Principal's human asset specificity	PrinHumAssetSpecificity	PrinHumAssetSpecificityOut
Principal's physical asset specificity	PrinDedAssetSpecificity	PrinDedAssetSpecificityOut
Principal's dedicated asset specificity	PrinProcAssetSpecificity	PrinProcAssetSpecificityOut
Principal's procedural asset specificity	PrinPhysAssetSpecificity	PrinPhysAssetSpecificityOut
Principal's temporal asset specificity	PrinTemporalSpecificity	PrinTemporalSpecificityOut
Principal's brand name capital exposure	PrinBrandCapExposure	PrinBrandCapExposureOut
Principal's proprietary info exposed	PrinPropInfoExposure	PrinPropInfoExposureOut
Agent's human asset specificity	AgenHumAssetSpecificity	AgenHumAssetSpecificityOut
Agent's physical asset specificity	AgenDedAssetSpecificity	AgenDedAssetSpecificityOut
Agent's dedicated asset specificity	AgenProcAssetSpecificity	AgenProcAssetSpecificityOut
Agent's procedural asset specificity	AgenPhysAssetSpecificity	AgenPhysAssetSpecificityOut
Agent's temporal asset specificity	AgenTemporalSpecificity	AgenTemporalSpecificityOut
Agent's brand name capital exposure	AgenBrandCapExposure	AgenBrandCapExposureOut
Agent's proprietary info exposed	AgenPropInfoExposure	AgenPropInfoExposureOut
Behavioural uncertainty (unreliability of suppliers)	BehUncerSuppUnreliability	BehUncerSuppUnreliabilityOut
Volume uncertainty (unpredictability of demand)	VolUncerPredictDemand	VolUncerPredictDemandOut
Speed of technological developments	TechUncerRapidDevelopments	TechUncerRapidDevelopmentsOut
Unpredictability of tech. developments	TechUncerUnpredictDevelopments	TechUncerUnpredictDevelopmentsOut
Technological Uncertainty (speed x unpredictability)	TechnologicalUncertainty	TechnologicalUncertaintyOut
Value assessment ability (task pricing ease)	ValueAssessPriceTasksEase	ValueAssessPriceTasksEaseOut
Contribution assessment ability (supplier evaluation ease)	ContrAssessDeterSuppPerforEase	ContrAssessDeterSuppPerforEaseOut
Transaction Frequency	TransactionFrequency	TransactionFrequencyOut

Table 9-2. SPSS variable label codebook - Dependency-based considerations

Conceptual designation of construct	Variable label (360 case dataset)	Variable label (195 case dataset)
Principal's resource criticality	PrinResourceCriticality	PrinResourceCriticalityOut
Principal's availability of altern. supply sources	PrinAvailOfSupplySources	PrinAvailOfSupplySourcesOut
Principal's potential for oligopolistic suppliers (1 / availability of altern. supply sources)	PrinPotForOligopSuppliers	PrinPotForOligopSuppliersOut
Principal's dependence on agents (Res. Criticality x potential for olig. suppliers)	PrinDependencePotential	PrinDependencePotentialOut
Agent's resource criticality	AgenResourceCriticality	AgenResourceCriticalityOut
Agent's availability of altern. supply outputs	AgenAvailOfSupplyOutputs	AgenAvailOfSupplyOutputsOut
Agent's potential for oligopsonistic clients (1 / availability of altern. supply outputs)	AgenPotForOligopClients	AgenPotForOligopClientsOut
Agent's dependence on principals (Res. Criticality x potential for olig. clients)	AgenDependencePotential	AgenDependencePotentialOut
Power imbalance (Principal's dependence - Agent's dependence)	PowerImbalanceSubtracted	PowerImbalanceSubtractedOut
Resource internalization potential (difficulty)	PrinInternPotentialDiff	PrinInternPotentialDiffOut
Cooptation potential	PrinCooptationPotential	PrinCooptationPotentialOut
Agent actual dependence (principal's input to agents' business)	PrinInputToAgenBusiness	PrinInputToAgenBusinessOut

Table 9-3. SPSS variable label codebook - Competence-based considerations

Conceptual designation of construct	Variable label (360 case dataset)	Variable label (195 case dataset)
Contribution to higher willingness-to-pay	ContrToGainsHigherPrices	ContrToGainsHigherPricesOut
Contribution to higher perceived benefits	ContrToGainsHigherBenefits	ContrToGainsHigherBenefitsOut
Contribution to higher gains (higher wtp + higher perc. benefits)	ContributionToHigherGains	ContributionToHigherGainsOut
Contribution to lower costs (allowance to compete on costs)	ContrToCostsCompeteOnCosts	ContrToCostsCompeteOnCostsOut
Potential contribution to higher wtp	PotContrToGainsHigherPrices	PotContrToGainsHigherPricesOut
Potential contribution to lower costs	PotContrToGainsCompeteOnCosts	PotContrToGainsCompeteOnCostsOut
Potential resource value (higher wtp + lower costs)	PotentialResourceValue	PotentialResourceValueOut
Natural resource scarcity (recruitment difficulty)	ResourceScarcityRecruitDiff	ResourceScarcityRecruitDiffOut
Resource complexity (included task complexity)	ResourceComplexity	ResourceComplexityOut
Resource tacitness (included task undefinedness)	ResourceTacitnessUndefinedTasks	ResourceTacitnessUndefinedTasksOut
Resource distance to performance (resource invisibility)	ResourceDistanceToPerformance	ResourceDistanceToPerformanceOut
Intrafirm causal ambiguity (complexity + tacitness + distance)	IntrafirmCausalAmbiguity	IntrafirmCausalAmbiguityOut
Interfirm causal ambiguity (resource interconnectedness)	ResourceInterconnected	ResourceInterconnectedOut
Resource social complexity (number of employees assigned)	ResourceSocialComplexity	ResourceSocialComplexityOut

Table 9-4. SPSS variable label codebook - Identity-based considerations

Conceptual designation of construct	Variable label (360 case dataset)	Variable label (195 case dataset)
Resource-identity coherence (alignment of activity with identity)	ResourceIdentityCoherence	ResourceIdentityCoherenceOut
Institutional forces influence	SourcingInfluenceInstitutional	SourcingInfluenceInstitutionalOut
Industrial forces influence	SourcingInfluenceIndustrial	SourcingInfluenceIndustrialOut

Table 9-5. SPSS variable label codebook - Dependent and Control variables

Conceptual designation of construct	Variable label (360 case dataset)	Variable label (195 case dataset)
Dependent variable		
Maintenance activity outsourcing	Cat2ActivityOutsourcing (binary variable)	ActivityOutsourcingOnly (continuous variable)
Control variables		
Marine shipping firm size (employees on shore)	CompanySizeEmplOnShore	CompanySizeEmplOnShoreOut
Marine shipping firm size (employees at sea)	CompanySizeEmplAtSea	CompanySizeEmplAtSeaOut
Marine shipping firm size (number of ships)	CompanySizeNumberOfShips	CompanySizeNumberOfShipsOut
Marine shipping firm size (ship total dead weight tonnage)	CompanySizeShipDWT	CompanySizeShipDWTOut
Marine shipping firm age	CompanyAge	CompanyAgeOut
Marine shipping firm average ship age	AverageShipAge	AverageShipAgeOut

9.3 Data screening

This section focuses on the preparatory screening of the empirical data collected and further reports on the study's measurement scale reliability estimates.

9.3.1 Variable normality, transformations and outliers

With regard to the data screening process, emphasis is placed on the distributional assumption of normality due to its pivotal role in the meaningful application of the parametric statistical analysis techniques utilized in this study. Normality is assessed both through statistical as well as graphical methods. Statistical indicators of normality include the Kolmogorov-Smirnov test (Lilliefors, 1967; Dallal and Wilkinson, 1986) as well as the Shapiro-Wilk test statistic (Shapiro and Wilk, 1965). Graphical assessment is performed through the visual inspection of the variables' frequency distribution histograms with the aid of superimposed normal curves. The study's preparatory screening process as well as the treatment of a host of other statistics related issues is informed by the formidably insightful work of Tabachnick and Fidell (2007) on the utilization of multivariate statistical analysis. All of the associated statistical functions and tests are performed through SPSS, version 20.0 (IBM, 2011).

The screening process is performed for each of the study's variables in an integrated way. Specifically, each of the variables is initially characterised and assessed with regard to its initial distributional attributes and normality properties in each of the two principal datasets of the study: the 360 case dataset slated for logistic regression and the 195 case dataset reserved for multiple linear regression. Subsequently, the screening process considers the application of data transformation techniques while further proceeding to the detection and removal of outliers (through the visual inspection of boxplots) with the aim of improving the variable's compliance with normality.

The preparatory data screening process for all of the study's variables is presented in detail in Appendix B.2. Tables 9-6 to 9-10 summarily report on the screening treatments finally applied to each variable. Post-treatments, the study argues for reasonable levels of normality compliance throughout the variables considered.

Table 9-6. Summative report of data screening treatments - Efficiency-based variables

Variable name[1]	360 case dataset treatments: Transformation applied	360 case dataset treatments: Outliers removed	195 case dataset treatments: Transformation applied	195 case dataset treatments: Outliers removed
PrinHumAssetSpecificity(Out)	Square root	None	Square root	None
PrinPhysAssetSpecificity(Out)	Square root	None	Square root	None
PrinDedAssetSpecificity(Out)	Square root	None	Square root	None
PrinProcAssetSpecificity(Out)	Square root	None	Square root	1 high
PrinTemporalSpecificity(Out)	Reflect & Sqrt	None	Reflect & Sqrt	None
PrinBrandCapExposure(Out)	Reflect & Sqrt	None	Reflect & Sqrt	None
PrinPropInfoExposure(Out)	Square root	None	Square root	None
AgenHumAssetSpecificity(Out)	None	5 low	None	5 low
AgenPhysAssetSpecificity(Out)	None	5 low	None	5 low
AgenDedAssetSpecificity(Out)	None	5 low	None	5 low
AgenProcAssetSpecificity(Out)	None	5 low	None	5 low
AgenTemporalSpecificity(Out)	None	5 low	None	5 low
AgenBrandCapExposure(Out)	None	5 low	None	5 low
AgenPropInfoExposure(Out)	Square root	4 low	Square root	1 high, 3 low
BehUncerSuppUnreliability(Out)	None	5 high	None	5 high
VolUncerPredictDemand(Out)	None	2 high	None	2 high
TechUncerRapidDevelopments(Out)	None	None	None	None
TechUncerUnpredictDevelopments(Out)	None	None	None	None
TechnologicalUncertainty(Out)	Square root	None	Square root	None
ValueAssessPriceTasksEase(Out)	None	None	None	None
ContrAssessDeterSuppPerforEase(Out)	None	None	None	None
TransactionFrequency(Out)	None	None	None	None

[1] Suffix '(Out)' refers to each variable's alternative designation in the 195 case dataset

Table 9-7. Summative report of data screening treatments - Dependency-based variables

Variable name[1]	360 case dataset treatments: Transformation applied	360 case dataset treatments: Outliers removed	195 case dataset treatments: Transformation applied	195 case dataset treatments: Outliers removed
PrinResourceCriticality(Out)	None	None	None	None
PrinAvailOfSupplySources(Out)	None	None	None	None
PrinPotForOligopSuppliers(Out)	None	None	None	None
PrinDependencePotential(Out)	Log10	None	Log10	None
AgenResourceCriticality(Out)	None	None	None	None
AgenAvailOfSupplyOutputs(Out)	None	None	None	None
AgenPotForOligopClients(Out)	None	None	None	None
AgenDependencePotential(Out)	Log10	None	Log10	None
PowerImbalanceSubtracted(Out)	(Not considered due to high mising value levels)			
PrinInternPotentialDiff(Out)	Square root	None	Square root	None
PrinCooptationPotential(Out)	None	None	None	None
PrinInputToAgenBusiness(Out)	Square root	None	Square root	None

[1] Suffix '(Out)' refers to each variable's alternative designation in the 195 case dataset

Table 9-8. Summative report of data screening treatments - Competence-based variables

	360 case dataset treatments		195 case dataset treatments	
Variable name[1]	Transformation applied	Outliers removed	Transformation applied	Outliers removed
ContrToGainsHigherPrices(Out)	None	None	None	None
ContrToGainsHigherBenefits(Out)	None	None	None	None
ContributionToHigherGains(Out)	None	None	None	None
ContrToCostsCompeteOnCosts(Out)	None	5 low	None	5 low
PotContrToGainsHigherPrices(Out)	None	None	None	None
PotContrToGainsCompeteOnCosts(Out)	None	None	None	None
PotentialResourceValue(Out)	None	None	None	None
ResourceScarcityRecruitDiff(Out)	None	None	None	None
ResourceComplexity(Out)	None	None	None	None
ResourceTacitnessUndefinedTasks(Out)	None	None	None	None
ResourceDistanceToPerformance(Out)	None	None	None	None
IntrafirmCausalAmbiguity(Out)	None	None	None	None
ResourceInterconnected(Out)	None	None	None	None
ResourceSocialComplexity(Out)	Square root	15 high	Square root	9 high

[1] Suffix '(Out)' refers to each variable's alternative designation in the 195 case dataset

Table 9-9. Summative report of data screening treatments - Identity-based variables

	360 case dataset treatments		195 case dataset treatments	
Variable name[1]	Transformation applied	Outliers removed	Transformation applied	Outliers removed
ResourceIdentityCoherence(Out)	None	5 low	None	5 low
SourcingInfluenceInstitutional(Out)	None	None	None	None
SourcingInfluenceIndustrial(Out)	None	None	None	None

[1] Suffix '(Out)' refers to each variable's alternative designation in the 195 case dataset

Table 9-10. Summative report of data screening treatments - Dependent and control variables

	360 case dataset treatments		195 case dataset treatments	
Variable name[1]	Transformation applied	Outliers removed	Transformation applied	Outliers removed
Dependent variable				
Maintenance activity outsourcing	(Categorical binary variable)		Log10	None
Control variables				
CompanySizeEmplOnShore(Out)	Log10	None	Log10	None
CompanySizeEmplAtSea(Out)	Log10	None	Log10	None
CompanySizeNumberOfShips(Out)	Log10	None	Log10	None
CompanySizeShipDWT(Out)	Log10	None	Log10	None
CompanyAge(Out)	Square root	None	Square root	None
AverageShipAge(Out)	Square root	None	Square root	None

[1] Suffix '(Out)' refers to each variable's alternative designation in the 195 case dataset

9.3.2 Measurement scale reliability estimates

Having concluded the screening and normality assessment of the different variables present in the study, emphasis is put on the reliability estimates of the study's measurement scales. As mentioned previously in the measurement model chapter of the thesis, the C-OAR-SE scale development method prompts the a posteriori calculation of a measurement scale's reliability estimate through the standard error formula of a sample population's mean (Rossiter, 2002). As such, the reliability estimates reported herein refer to the maximum statistical error in responses to unipolar Likert-like continuous measurement scales rated on a 0 to 7 numerical scheme and accompanied by the "not at all", "slightly", "quite" and "extremely" verbal labels anchored at the '0', '2', '4' and '6' numerical points respectively. The scales enumeration scheme allows the responses to range freely from 0.00 up to 7.00 in 0.01 increment widths.

For the purposes of this study a 95% confidence interval is assumed (a=.05). Thus, a z-value of 1.96 is retained for the reliability analysis. Furthermore, given the finite nature of the deep-sea marine shipping sector, the standard error formula is augmented by the Finite Population Correction (FPC) factor. The total population size is calculated by assuming the presence of six activities associated with a firm's main engine maintenance requirements and using the study's sampling frame of 241 firms as a proxy for the total number of deep-sea marine shipping firms. As such the total population size (N) at the maintenance activity level is 1446 (6 x 241). Finally, the sample size (n) is represented by the number of valid responses returned in each measurement scale. For reference purposes, it is reiterated here that the final reliability estimates in percentile form are given by the subtraction of the maximum error (i.e. the sum of the + and – errors) from 1, followed by the result's multiplication by 100. Tables 9-11 to 9-14 report on the reliability estimate calculations of the study's psychometric measurement scales.

Table 9-11. Measurement scale reliability estimates (a =.05) - Efficiency-based construct measures

	Sample size	Stand. dev.	Interim calc.	FPC	mean est. CI	Scale reliability	
Construct measurement scale	n	σ	$\frac{\sigma}{\sqrt{n}}$	$\sqrt{\frac{(N-n)}{(N-1)}}$	$\mu \pm$	R	$R\%$
Principal's human asset specificity	322	1.550	.086	.882	.149	.701	70.1%
Principal's physical asset specificity	324	1.444	.080	.881	.139	.723	72.3%
Principal's dedicated asset specificity	321	1.315	.073	.882	.127	.746	74.6%
Principal's procedural asset specificity	325	1.530	.085	.881	.147	.707	70.7%
Principal's temporal asset specificity	350	1.321	.071	.871	.121	.759	75.9%
Principal's brand name capital exposure	352	1.343	.072	.870	.122	.756	75.6%
Principal's proprietary info exposed	301	1.311	.076	.890	.132	.736	73.6%
Agent's human asset specificity	306	1.687	.096	.888	.168	.664	66.4%
Agent's physical asset specificity	294	1.710	.100	.893	.175	.651	65.1%
Agent's dedicated asset specificity	301	1.596	.092	.890	.160	.679	67.9%
Agent's procedural asset specificity	305	1.626	.093	.889	.162	.676	67.6%
Agent's temporal asset specificity	298	1.995	.116	.891	.202	.596	59.6%
Agent's brand name capital exposure	263	1.432	.088	.905	.157	.687	68.7%
Agent's proprietary info exposed	307	1.311	.075	.888	.130	.740	74.0%
Behavioural uncertainty (unreliability)	324	1.130	.063	.881	.108	.783	78.3%
Volume uncertainty (demand unpredictability)	326	1.704	.094	.880	.163	.674	67.4%
Speed of technological developments	319	1.315	.074	.883	.127	.745	74.5%
Unpredictability of tech. developments	324	1.407	.078	.881	.135	.730	73.0%
Value assessment ability (pricing ease)	331	1.476	.081	.878	.140	.721	72.1%
Contribution assessment ability (eval. ease)	314	1.384	.078	.885	.135	.729	72.9%
Transaction Frequency	334	1.895	.104	.877	.178	.643	64.3%

z=1.96. N=1446.

Table 9-12. Measurement scale reliability estimates (a=.05) - Dependency-based construct measures

	Sample size	Stand. dev.	Interim calc.	FPC	mean est. CI	Scale reliability	
Construct measurement scale	n	σ	$\frac{\sigma}{\sqrt{n}}$	$\sqrt{\frac{(N-n)}{(N-1)}}$	$\mu \pm$	R	$R\%$
Principal's resource criticality	350	1.508	.081	.871	.138	.725	72.5%
Agent's resource criticality	275	1.469	.089	.900	.156	.687	68.7%
Resource internalization potential (difficulty)	320	1.730	.097	.883	.167	.665	66.5%
Cooptation potential	302	1.635	.094	.890	.164	.672	67.2%

z=1.96. N=1446.

Table 9-13. Measurement scale reliability estimates (a=.05) - Competence-based construct measures

	Sample size	Stand. dev.	Interim calc.	FPC	mean est. CI	Scale reliability	
Construct measurement scale	n	σ	$\frac{\sigma}{\sqrt{n}}$	$\sqrt{\frac{(N-n)}{(N-1)}}$	$\mu \pm$	R	$R\%$
Contribution to higher willingness-to-pay	316	1.976	.111	.884	.193	.615	61.5%
Contribution to higher perceived benefits	323	1.718	.096	.882	.165	.670	67.0%
Contribution to lower costs (allowance to compete on costs)	322	1.712	.095	.882	.165	.670	67.0%
Potential contribution to higher wtp	322	1.741	.097	.882	.168	.665	66.5%
Potential contribution to lower costs	321	1.769	.099	.882	.171	.658	65.8%
Natural resource scarcity (recruitment difficulty)	320	1.688	.094	.883	.163	.673	67.3%
Resource complexity (included task complexity)	332	1.459	.080	.878	.138	.724	72.4%
Resource tacitness (included task undefinedness)	325	1.585	.088	.881	.152	.696	69.6%
Resource distance to performance (resource invisibility)	323	1.339	.075	.882	.129	.743	74.3%
Interfirm causal ambiguity (resource interconnectedness)	322	1.561	.087	.882	.150	.699	69.9%

z=1.96. N=1446.

Table 9-14. Measurement scale reliability estimates (a=.05) - Identity-based construct measures

	Sample size	Stand. dev.	Interim calc.	FPC	mean est. CI	Scale reliability	
Construct measurement scale	n	σ	$\frac{\sigma}{\sqrt{n}}$	$\sqrt{\frac{(N-n)}{(N-1)}}$	$\mu \pm$	R	$R\%$
Resource-identity coherence	344	1.096	.059	.873	.101	.798	79.8%
Institutional forces influence	360	1.146	.060	.867	.103	.795	79.5%
Industrial forces influence	360	1.490	.079	.867	.133	.733	73.3%

z=1.96. N=1446.

9.4 Missing value analysis and treatments

Having concluded the screening process for all of the study's variables, this section reports on the levels and attributes of missing values observed in each variable within the context of the empirical analysis's two datasets (i.e. the 360 case all-inclusive dataset and the 195 case outsourcing only dataset). Furthermore, the section discusses and reports an imputation strategy for dealing with the study's missing values.

9.4.1 Missing value reports

Table 9-15 reports the missing value statistics of the efficiency-based variables included in the study's two datasets. Specifically, the table includes the absolute number of values missing from each dataset (or otherwise the number of missing values present in each dataset) along with a respective percentage estimate.

Table 9-15. Missing values report - Efficiency-based variables

Construct/variable	360 case dataset (N=360) No. of values missing	360 case dataset (N=360) % of values missing	195 case dataset (N=195) No. of values missing	195 case dataset (N=195) % of values missing
Principal's human asset specificity	38	10.56%	16	8.21%
Principal's physical asset specificity	36	10.00%	13	6.67%
Principal's dedicated asset specificity	39	10.83%	18	9.23%
Principal's procedural asset specificity	35	9.72%	17	8.72%
Principal's temporal asset specificity	10	2.78%	4	2.05%
Principal's brand name capital exposure	8	2.22%	3	1.54%
Principal's proprietary info exposed	59	16.39%	28	14.36%
Agent's human asset specificity	54	15.00%	27	13.85%
Agent's physical asset specificity	66	18.33%	35	17.95%
Agent's dedicated asset specificity	59	16.39%	28	14.36%
Agent's procedural asset specificity	55	15.28%	28	14.36%
Agent's temporal asset specificity	62	17.22%	36	18.46%
Agent's brand name capital exposure	97	26.94%	52	26.67%
Agent's proprietary info exposed	53	14.72%	25	12.82%
Behavioural uncertainty (unreliability)	36	10.00%	15	7.69%
Volume uncertainty (demand unpredictability)	34	9.44%	16	8.21%
Speed of technological developments	41	11.39%	25	12.82%
Unpredictability of tech. developments	36	10.00%	17	8.72%
Technological Uncertainty (speed x unpred.)	53	14.72%	36	18.46%
Value assessment ability (pricing ease)	29	8.06%	15	7.69%
Contribution assessment ability (evaluation ease)	46	12.78%	14	7.18%
Transaction Frequency	26	7.22%	11	5.64%

From a quick browsing of the relevant table it is noted that the principals' asset specificity variables generally present a satisfactory missing value profile with the number of missing data points never exceeding 11% of the total value count in the 360 case dataset and 9.5% in the 195 case dataset. The principal's proprietary asset exposure variables (i.e. brand capital and proprietary info exposure) contrast each other as the first lingers around the 2% missing value mark while the second exceeds 16% in the 360 case dataset and 14% in the 195 case dataset. The missing value statistics are further inflated when considering the agents' asset specificity and proprietary asset exposure variables. In the first case, the variables hold an average missing value count of approximately 16% in both datasets. In the second case, the variables average around 20% again in both datasets. The rest of the efficiency-based variables consistently remain around an average of 10% in the 360 case dataset and 8.3% in the 195 case dataset (exacerbated mostly by the increased missing value count of the speed of technological developments variable).

Table 9-16 reports the missing value statistics of the dependency-based variables included in the study's two datasets. A series of interesting missing value characteristics is revealed when examining the particular table. First of all, in considering the forming variables of the principals' dependence, it is evidenced that while the resource criticality variable never exceeds a total missing value count of 3%, the availability of alternative supply sources approaches the 17% mark in the 360 case dataset and exceeds 11% in the 195 case dataset. The fact finally yields a composite missing value count for the principals' dependence variable that nears 19.5% in the all-inclusive dataset and nearly 13% in the 195 case dataset. The pattern is, unfortunately, intensified when considering the respective forming variables of the agents' dependence. In this case, the agent's exchanged resource criticality variable tallies well over 20% of the values missing with the availability of alternative supply outputs consistently surpassing the 50% mark. Thus, the agents' dependence variable yields a composite missing value count of more than 57% in the 360 case dataset and almost 53% in the 195 case dataset.

Table 9-16. Missing values report - Dependency-based variables

Construct/variable	360 case dataset (N=360)		195 case dataset (N=195)	
	No. of values missing	% of values missing	No. of values missing	% of values missing
Principal's resource criticality	10	2.78%	3	1.54%
Principal's availability of altern. supply sources	60	16.67%	22	11.28%
Principal's potential for oligopolistic suppliers (1 / availability of altern. supply sources)	60	16.67%	22	11.28%
Principal's dependence on agents (Res. critic. x pot. for oligop. suppliers)	70	19.44%	25	12.82%
Agent's resource criticality	85	23.61%	40	20.51%
Agent's availability of altern. supply outputs	198	55.00%	99	50.77%
Agent's potential for oligopsonistic clients (1 / availability of altern. supply outputs)	198	55.00%	99	50.77%
Agent's dependence on principals (Res. critic. x pot. for oligop. clients)	206	57.22%	103	52.82%
Power imbalance (Princ.depen. - Agen.dep.)	219	60.83%	110	56.41%
Resource internalization potential (difficulty)	40	11.11%	19	9.74%
Cooptation potential	58	16.11%	23	11.79%
Agent actual dependence	152	42.22%	76	38.97%

What is of particular consequence, in this case, is that the aforementioned statistics finally result in a disruptive missing value count for the overarching power imbalance variable. In the 360 case dataset the particular variable counts more than 60% of the values missing, while in the 195 case dataset the variable surpasses the 56% mark. In light of these facts, it is thus deemed prudent to exclude the power imbalance variable from consideration in further statistical analyses. By association, this exclusion further covers the agent's dependence variable along with its forming lower-order variables as the construct's associated measures are identified as the source of the missing value issue. In contrast, the variable that may meaningfully remain under consideration for further statistical analyses, due to its accommodating missing value characteristics, is the principal's dependence. As such, the specific variable is held to act as a proxy for the strategic framework's main dependence consideration.

Focussing finally on the rest of the dependency-based variables, it is worth mentioning that a similar missing value count issue emerges in the agents' actual dependence variable. Though less severe an issue, when compared with the aforementioned predicament, the actual dependence variable presents worryingly high missing value counts in both datasets that approximate the 40% mark. Nevertheless, the variable is retained for further consideration in light of its novelty in considering a previously overlooked consideration. The rest of the variables associated with this perspective exhibit satisfying missing value characteristics.

Table 9-17 reports the missing value statistics of the competence-based variables included in the study's two datasets. Of interest, in this table is perhaps the overall healthy image presented by the perspective's variables. The sum of the variables included here exhibit an average missing value count of 10.6% in the 360 case dataset and a 9.7% in the 195 case dataset, with no particular extremes worth mentioning. Naturally, the composite missing value counts of formed variables are inflated as they reflect the sums of complete cases. For example, while the forming variables of intrafirm causal ambiguity hold an average of 8.5% of the values missing in the 195 case dataset, the formed causal ambiguity variable boasts a 20% missing value tally within the same dataset. This phenomenon will be discussed further when arguing for the desirability of missing value imputations.

Table 9-17. Missing values report - Competence-based variables

Construct/variable	360 case dataset (N=360)		195 case dataset (N=195)	
	No. of values missing	% of values missing	No. of values missing	% of values missing
Contribution to higher willingness-to-pay	44	12.22%	21	10.77%
Contribution to higher perceived benefits	37	10.28%	20	10.26%
Contribution to higher gains (higher wtp + higher perc. benefits)	55	15.28%	29	14.87%
Contribution to lower costs (allowance to compete on costs)	38	10.56%	19	9.74%
Potential contribution to higher wtp	38	10.56%	18	9.23%
Potential contribution to lower costs	39	10.83%	16	8.21%
Potential resource value (higher wtp + lower costs)	51	14.17%	22	11.28%
Natural resource scarcity (recruitment difficulty)	40	11.11%	18	9.23%
Resource complexity (included task complexity)	28	7.78%	12	6.15%
Resource tacitness (included task undefinedness)	35	9.72%	19	9.74%
Resource distance to performance (resource invisibility)	37	10.28%	19	9.74%
Intrafirm causal ambiguity (complexity + tacitness + distance)	70	19.44%	39	20.00%
Interfirm causal ambiguity (resource interconnectedness)	38	10.56%	20	10.26%
Resource social complexity (number of employees assigned)	47	13.06%	27	13.85%

Table 9-18, in turn, reports the missing value statistics of the identity-based variables included in the study's two datasets. The only significant point of note here is the limited number of missing values present in the perspective's main variable along with their complete absence in the rest.

Table 9-18. Missing values report - Identity-based variables

Construct/variable	360 case dataset (N=360)		195 case dataset (N=195)	
	No. of values missing	% of values missing	No. of values missing	% of values missing
Resource-identity coherence	16	4.44%	11	5.64%
Institutional forces influence	0	0.00%	0	0.00%
Industrial forces influence	0	0.00%	0	0.00%

Table 9-19, finally, reports the missing value statistics of the dependent and control variables included in the study's two datasets. Once more, it is the absence of missing values that is worth underlining in this case as well. As observed in the related table, no missing values are associated with either the study's dependent or control variables within both datasets.

Table 9-19. Missing values report - Dependent and control variables

Construct/variable	360 case dataset (N=360) No. of values missing	360 case dataset (N=360) % of values missing	195 case dataset (N=195) No. of values missing	195 case dataset (N=195) % of values missing
Dependent variable				
Maintenance activity outsourcing	0	0.00%	0	0.00%
Control variables				
Marine shipping firm size (employees on shore)	0	0.00%	0	0.00%
Marine shipping firm size (employees at sea)	0	0.00%	0	0.00%
Marine shipping firm size (number of ships)	0	0.00%	0	0.00%
Marine shipping firm size (ship total dead weight tonnage)	0	0.00%	0	0.00%
Marine shipping firm age	0	0.00%	0	0.00%
Marine shipping firm average ship age	0	0.00%	0	0.00%

The principle reason behind the absence of missing values in this variable segment is recognized as the diligent reporting of respondents to these straight-forward measures. With regard to the dependent variables, a set of validation checks in the on-line survey instrument ensured completion of the associated measures.

9.4.2 Missing value randomness analysis

As noted by Tabachnick and Fidell (2007), a missing value related issue of interest in any variance-based study, is the randomness of missing values. As such, this section reports on the missing value pattern characteristics of the variables included in the study's two datasets.

Ordered in hierarchical succession of randomness, from high to low, missing data points can be reported as Missing Completely at Random (MCAR), Missing at Random (MAR) and Missing Not at Random (MNAR) (Heitjan and Basu, 1996). Otherwise classified as ignorable nonresponse and non-ignorable nonresponse (Tabachnick and Fidell, 2007 p.62) the characteristics of missing value patterns are mostly concerned with the generalizability of inferences derived from variance-based tests. As such, if non-random (or otherwise systematic) patterns of missing values are present in a dataset, then it is foreseeable that some unknown external factor influences which responses are present and which are absent from the dataset. As per Tabachnick and Fidell's (2007) instructions, the principle avenues for testing the aforementioned ignorability conditions include Little's MCAR test (Little, 1988) as well as the examination of inter-variable separate variance t tests in cases where the MCAR test is found to be statistically significant (a non-significant result indicates MCAR).

The examination of missing value patterns within each of the study's variable segments (i.e. the efficiency, dependency, competence and identity-based variable groups), is performed here separately for conceptually cohesive groups of variables accompanied each time by the study's main dependent variable. For example, with regard to the efficiency-based variable group, the variables included in the principals' asset specificity construct are tested together along with the maintenance activity outsourcing levels. This partitioning segmentation is principally performed to ensure the manageability of the process for the study's increased number of variables under consideration. All of the relevant calculations are performed through SPSS, version 20.0 (IBM, 2011).

Given the discussion above, Table 9-20 reports on the statistical significance levels of Little's MCAR test in each of the variable groups identified within the efficiency-based variable segment in both of the study's datasets. As indicated in the table, the MCAR test statistic yielded statistically significant results (at the .05 level) in the case of the principal's asset specificity as well as the case of the value and contribution assessment ability variables. Further examination of the missing value patterns through separate variance t tests did not reveal systematic missingness among the variables. As such, MAR is inferred.

Table 9-20. Missing value analysis - Efficiency-based variable groups

	360 case dataset (N=360)	195 case dataset (N=195)
Construct/variable group	Little's MCAR test (sig.)	Little's MCAR test (sig.)
Principal's asset specificity variables	.020	.000
Principal's proprietary asset exposure variables	.491	.840
Agent's asset specificity variables	.092	.506
Agent's proprietary asset exposure variables	.063	.161
Behavioural & volume Uncertainty variables	.452	.147
Technological uncertainty variables	.321	.763
Value & contribution assessment ability variables	.026	.011
Transaction Frequency	.950	.326

Table 9-21 reports on the statistical significance levels of Little's MCAR test in each of the variable groups identified within the dependency-based variable segment in both of the study's datasets. In this case, further examinations were conducted with regard to the principal's and agent's dependence variables, an issue already covered in the missing values report section of this chapter. Reiteratively, it is diagnosed here that MAR cannot be inferred and that non-ignorable nonresponse is present particularly in reference to the agent's dependence variables. In short, it is asserted that the survey's respondents exhibited greater reluctance when conferring judgment over issues related to corporate entities other than their own (in this case a focal shipping firm's maintenance suppliers).

Table 9-21. Missing value analysis - Dependency-based variable groups

	360 case dataset (N=360)	195 case dataset (N=195)
Construct/variable group	Little's MCAR test (sig.)	Little's MCAR test (sig.)
Principal's dependence variables (Res. criticality & avail. of altern. sources)	.002	.149
Agent's dependence variables (Res. criticality & avail. of altern. outputs)	.004	.093
Resource internalization potential (difficulty)	.168	.855
Cooptation potential & Agent actual dependence	.176	.058

Table 9-22 reports on the statistical significance levels of Little's MCAR test in each of the variable groups identified within the competence-based variable segment in both of the study's datasets. In this case, the MCAR test statistic yielded statistically significant results (at the .05 as well as the .01 level) in the case of resource value as well as causal ambiguity variables. Further examination of the missing value patterns through separate variance t tests, however, did not reveal a discernible systematic pattern of missingness among the variables. As such, MAR is inferred.

Table 9-22. Missing value analysis - Competence-based variable groups

	360 case dataset (N=360)	195 case dataset (N=195)
Construct/variable group	Little's MCAR test (sig.)	Little's MCAR test (sig.)
Resource value variables	.000	.018
Potential resource value variables	.072	.704
Natural resource scarcity	.160	.863
Causal ambiguity variables	.000	.016
Resource social complexity	.442	.257

Table 9-23, finally reports on the statistical significance levels of Little's MCAR test in each of the variable groups identified within the identity-based variable segment in both of the study's datasets. In the relative absence of missing values within this segment, the only test that was further examined regarded resource-identity coherence in the 195 case dataset. MAR was finally inferred.

Table 9-23. Missing value analysis - Identity-based variable groups

	360 case dataset (N=360)	195 case dataset (N=195)
Construct/variable group	Little's MCAR test (sig.)	Little's MCAR test (sig.)
Resource-identity coherence	.289	.038
External forces influence	No missing values	No missing values

9.4.3 The case for missing value imputations

Earlier in the chapter, during the missing value report section, the phenomenon of inflated missing value counts for composite variables was observed. In essence, the issue revolves around the fact that to properly calculate a composite variable with multiple forming components (lower-order variables), all forming components need to simultaneously report a case value for aggregation. Otherwise, the composite is not properly defined (i.e. there are parts of it missing) and the calculation is incomplete. In other words, in the case of a composite variable with three forming components, even if two components return a validly reported value, the possible absence of the third prevents the aggregated measure from being formed. This condition, however, results in a loss of otherwise potentially useful information. As such, an argument is made here for the use of a missing value imputation strategy intended to mitigate the aforementioned loss.

An example of the loss of potentially useful information (in this case variance) was witnessed in the missing value report section with regard to intrafirm causal ambiguity. The particular composite variable, formed through the aggregation of the resource complexity, resource tacitness and resource distance to performance variables, exhibited a compound missing value level of 20% in the 195 case dataset. At the same time, however, the forming variables exhibited missing value levels of 6.2%, 9.7% and 9.7% respectively within the same dataset. As such, while there was partial valid information concerning at least 183 of the 195 cases included in the dataset, only 156 'complete' cases were considered and the partial information was, by default, discarded. Thus, it is put forth that further statistical analyses would benefit from the adoption of a missing value imputation strategy intended to complement the existing data and alleviate the information loss issue.

Given the relative strengths and weaknesses of the alternative missing value estimation tactics discussed by Tabachnick and Fidell (2007 pp.66-70), a regression-based approach is adopted. In this type of missing value estimation, other variables are used as independent predictors in a regression equation with the variable with missing values serving as the dependent outcome. Data from complete cases is used to generate the regression equation while finally the regression's outcome results substitute the missing values. At this point, it is worth noting that only a first round of regression equations is generated for the needs of this study (i.e. the regression methodology is not used reiteratively in some attempt at convergence).

An issue that always concerns this type of missing value imputation strategy is the existence of good predictors for the variables with missing data (ibid). To tackle this issue, the imputation method is applied separately to conceptually cohesive groups of variables within each of the study's overarching variable segments (i.e. within the efficiency, dependency, competence and identity-based variable groups). For example, the imputation of principals' asset specificity component values is performed with the use of only the principal's asset specificity variables. Finally, to alleviate over-consistency issues, the imputed values are augmented with a random component (in this case a residual randomly selected from a complete case). All of the relevant imputations are performed through SPSS, version 20.0 (IBM, 2011).

With the formation of the two additional imputed datasets, four datasets in total are considered. Two containing all of the study's maintenance activity cases (original and imputed) and two containing only the maintenance activity cases where the activity is outsourced to any degree (original and imputed). Tables 9-24 to 9-28 present the means and standard deviations of the study's variables in the original and imputed 360 case and 195 case datasets.

Table 9-24. Original and imputed variable statistics - Efficiency-based variables

	360 case original dataset		360 case imputed dataset		195 case original dataset		195 case imputed dataset	
Construct/variable	Mean	St.Dev.	Mean	St.Dev.	Mean	St.Dev.	Mean	St.Dev.
Principal's human asset specificity (TRsqrt)	1.31	.585	1.27	.592	1.36	.560	1.35	.566
Principal's physical asset specificity (TRsqrt)	1.01	.593	1.01	.581	1.04	.586	1.03	.572
Principal's dedicated asset specificity (TRsqrt)	1.01	.559	1.02	.571	1.05	.521	1.06	.506
Principal's procedural asset specificity (TRsqrt)	1.17	.588	1.16	.585	1.23	.568	1.22	.557
Principal's temporal asset specificity (TRsqrtRflct)	1.57	.601	1.57	.600	1.63	.597	1.64	.597
Principal's brand name capital exposure (TRsqrtRflct)	1.61	.611	1.62	.613	1.66	.610	1.66	.605
Principal's proprietary info exposed (TRsqrt)	1.33	.509	1.31	.525	1.36	.481	1.36	.484
Agent's human asset specificity	4.06	1.687	4.04	1.696	4.11	1.563	4.10	1.562
Agent's physical asset specificity	3.93	1.710	3.91	1.688	3.98	1.571	3.98	1.530
Agent's dedicated asset specificity	3.90	1.596	3.94	1.596	3.92	1.432	4.03	1.477
Agent's procedural asset specificity	3.78	1.626	3.82	1.578	3.92	1.531	3.89	1.520
Agent's temporal asset specificity	3.98	1.995	3.90	2.055	4.17	1.775	4.20	1.706
Agent's brand name capital exposure	3.45	1.432	3.44	1.407	3.61	1.315	3.61	1.344
Agent's proprietary info exposed (TRsqrt)	1.48	.462	1.47	.490	1.53	.385	1.50	.453
Behavioural uncertainty (unreliability)	2.53	1.130	2.52	1.104	2.50	1.070	2.46	1.071
Volume uncertainty (demand unpredictability)	2.71	1.704	2.71	1.701	3.14	1.674	3.11	1.659
Speed of technological developments	2.89	1.315	2.92	1.292	3.01	1.263	3.02	1.268
Unpredictability of tech. developments	3.70	1.407	3.67	1.402	3.89	1.291	3.89	1.267
Technological Uncertainty (TRsqrt) (speed x unpred.)	3.06	.937	3.07	.919	3.26	.904	3.26	.893
Value assessment ability (pricing ease)	3.95	1.476	3.96	1.458	3.66	1.559	3.57	1.562
Contribution assessment ability (evaluation ease)	4.94	1.384	4.91	1.363	4.69	1.354	4.69	1.346
Transaction Frequency	4.04	1.895	4.05	1.871	3.88	1.718	3.88	1.744

Table 9-25. Original and imputed variable statistics - Dependency-based variables

	360 case original dataset		360 case imputed dataset		195 case original dataset		195 case imputed dataset	
Construct/variable	Mean	St.Dev.	Mean	St.Dev.	Mean	St.Dev.	Mean	St.Dev.
Principal's resource criticality	5.30	1.508	5.30		5.40	1.513	5.37	1.545
Principal's potential for oligopolistic suppliers (1 / availability of altern. supply sources)	0.21	.280	0.20		0.196	.249	0.19	.239
Principal's dependence on agents (TRlog10) (Res. critic. x pot. for oligop. suppliers)	-0.34	.639	-0.35		-0.31	.579	-0.31	.563
Agent's resource criticality	(No longer considered in the analysis)							
Agent's potential for oligopsonistic clients (1 / availability of altern. supply outputs)	(No longer considered in the analysis)							
Agent's dependence on principals (TRlog10) (Res. critic. x pot. for oligop. clients)	(No longer considered in the analysis)							
Power imbalance (Princ.depen. - Agen.dep.)	(No longer considered in the analysis)							
Resource internalization potential (difficulty) (TRsqrt)	1.48	.602	1.49		1.56	.567	1.54	.563
Cooptation potential	2.99	1.635	2.96		3.03	1.610	3.10	1.659
Agent actual dependence (TRsqrt)	2.25	1.800	2.18		2.20	1.741	2.14	1.734

Table 9-26. Original and imputed variable statistics - Competence-based variables

	360 case original dataset		360 case imputed dataset		195 case original dataset		195 case imputed dataset	
Construct/variable	Mean	St.Dev.	Mean	St.Dev.	Mean	St.Dev.	Mean	St.Dev.
Contribution to higher willingness-to-pay	2.93	1.976	2.99	1.985	3.08	2.074	3.02	2.077
Contribution to higher perceived benefits	4.17	1.718	4.15	1.714	4.45	1.577	4.42	1.605
Contribution to higher gains (higher wtp + higher perc. benefits)	7.12	3.236	7.15	3.187	7.60	3.168	7.44	3.112
Contribution to lower costs (allowance to compete on costs)	3.71	1.712	3.64	1.706	3.73	1.625	3.66	1.662
Potential contribution to higher wtp	2.68	1.741	2.61	1.764	2.88	1.874	2.88	1.891
Potential contribution to lower costs	3.62	1.769	3.56	1.807	3.65	1.764	3.72	1.757
Potential resource value (higher wtp + lower costs)	6.29	2.863	6.18	2.869	6.54	3.071	6.59	2.990
Natural resource scarcity (recruitment difficulty)	3.21	1.688	3.15	1.616	3.62	1.656	3.70	1.699
Resource complexity (included task complexity)	3.43	1.459	3.42	1.387	3.71	1.414	3.66	1.348
Resource tacitness (included task undefinedness)	2.46	1.585	2.44	1.567	2.55	1.422	2.54	1.396
Resource distance to performance (resource invisibility)	2.39	1.339	2.46	1.371	2.30	1.323	2.37	1.371
Intrafirm causal ambiguity (complexity + tacitness + distance)	8.27	2.496	8.31	2.505	8.45	2.333	8.57	2.323
Interfirm causal ambiguity (resource interconnectedness)	4.76	1.561	4.77	1.527	4.93	1.438	4.89	1.416
Resource social complexity (TRsqrt) (number of employees assigned)	1.94	.833	1.94	.834	1.99	.838	2.00	.836

Table 9-27. Original and imputed variable statistics - Identity-based variables

	360 case original dataset		360 case imputed dataset		195 case original dataset		195 case imputed dataset	
Construct/variable	Mean	St.Dev.	Mean	St.Dev.	Mean	St.Dev.	Mean	St.Dev.
Resource-identity coherence	5.03	1.096	5.03	1.091	5.02	1.014	4.94	1.086
Institutional forces influence	5.15	1.146	No imputations needed		5.12	1.062	No imputations needed	
Industrial forces influence	3.42	1.490			3.40	1.511		

Table 9-28. Original and imputed variable statistics - Control variables

	360 case original dataset		360 case imputed dataset		195 case original dataset		195 case imputed dataset	
Construct/variable	Mean	St.Dev.	Mean	St.Dev.	Mean	St.Dev.	Mean	St.Dev.
Company size - Employees on shore (TRlog10)	1.66	.437	No imputations needed		1.66	.438	No imputations needed	
Company size - Employees at sea (TRlog10)	2.58	.517			2.60	.507		
Company size - Number of ships (TRlog10)	1.14	.501			1.16	.485		
Company size - Total DWT (TRlog10)	5.94	.641			5.93	.619		
Company Age (TRsqrt)	6.01	2.530			6.02	2.571		
Average Ship Age (TRsqrt)	2.92	.722			2.89	.726		

9.5 Impact of considerations on decisions to outsource: logistic regression

Having concluded all of the necessary data screening and dataset preparation processes, emphasis is now put on the exploration of the study's hypotheses through statistical regression techniques. Primarily, focus is put on the application of logistic regression analysis in the study's all inclusive 360 case datasets (with emphasis put primarily on the imputed rather than the original dataset for reasons explained later in this introduction). The aim of the analysis is to investigate whether and which considerations from each of the study's strategic perspectives (i.e. efficiency, dependency, competence and identity) significantly influence shipping firm decisions to outsource or not activities targeted by transactionally servitized offerings. As such, in this regression analysis technique, the dependent outcome is defined as a categorical variable depicting the state of a particular activity (0: not outsourced; 1: outsourced to any degree). The variable is identified in the datasets through the Cat2ActivityOutsourcing variable label.

A hierarchical (or otherwise stepwise or sequential) approach to the application of logistic regression is adopted. In accordance with this technique, variables or groups of variables (variable blocks) are entered into the logistic regression equation hierarchically (in sequence) according to theoretical concerns. As such, each independent variable (or block of variables) entered in the equation is assessed in terms of improvements in model fit (correct classification of cases in the two different state groups: non-outsourced and outsourced state). Model fit is initially assessed through the comparison of a predictor-based model with the constant-only model (a model with no predictor independent variables). If the model fit improvement test is not significant then the examined variables (or blocks) are excluded from the regression model and the next set of variables is entered and assessed. If the contribution is found significant, then the variable or block is retained in the model and the next set of variables is entered and assessed. Subsequent models are compared against the previous statistically significant predictor-based model for further model fit improvements. All model fit tests are performed through the log-likelihood χ^2 technique reported as the omnibus test of model coefficients in SPSS (Tabachnick and Fidell, 2007 p. 458). The logistic regression model-building process is repeated until there are no more variables left to enter the equation, at which point a parsimonious regression model is retrieved.

In applying sequential logistic regression analysis, a limited number of assumptions (when compared with other regression techniques) are taken into consideration. These include the absence of outliers and multicollinearity between independent variables as well as the independence of errors. (Tabachnick and Fidell, 2007 p. 443). Outlier concerns have already been addressed in the study's data screening process. Multicollinearity checks are performed through a visual inspection of each regression's associated variable correlation matrix. The independence of errors, finally, is addressed through the research design that ensures the consideration of independent sourcing decisions in a between-subjects analysis approach. No specific distributional assumptions are considered with regard to the independent variables; a fact rendering logistic regression one of the more accommodating statistical analysis techniques. Nevertheless, it is reported that normally distributed predictors may enhance the power of the analysis (Tabachnick and Fidell, 2007 p. 442). As such, the transformed versions of variables are considered where necessary.

The following sub-sections report the application of the logistic regression model-building process for each of the strategic considerations after the assessment of the study's control variables (individual model specifics are offered in Appendix B.3). In reporting the results of the study's hierarchical logistic regression analyses, an independent variable correlation matrix is first offered to be then followed by two associated results tables.

The first results table reports the predictor variables' B coefficients along with their statistical significance and standard errors within each model run. Each model's respective log-likelihood χ^2 test of improvement of model fit is presented at the end of each model's column, indicated as Chi-square Δ. The measure indicates change in the chi-square statistic upon the entrance of predictor variables in the logistic regression equation and is reported along with its statistical significance (only variables incurring statistically significant improvements are retained). Furthermore, an approximation of the R^2 measure of explained variance (otherwise referred to as pseudo-R^2 in the context of logistic regression) is offered in the form of Nagelkerke's generalized R^2 (Nagelkerke, 1991; Tabachnick and Fidell, 2007 p. 461). The generalized R^2 measure as well as changes incurred to it by the entrance of predictor variables in the equation is reported for each model run above the Chi-square Δ statistic (indicated Nagelkerke's R^2 and Nagelkerker's Δ R^2 respectively).

The second results table reports the predictor variables' odds ratios along with their respective lower and upper confidence intervals (indicated as 'Odds', 'Low' and 'High' respectively). Odds ratios refer to changes incurred in the odds of an outcome state when the value of a predictor variable increases by one unit (Tabachnick and Fidell, 2007 p. 461). In the two outcome category scheme utilized in the study, non-outsourced activities are referred to be in a '0' outcome state while activities outsourced to any degree are referred as being in a '1' outcome state. Within such a categorization, odds ratios greater than one indicate the increase in the odds of the state outcome '1' incurred by a one-unit increase in the predictor variable under examination. For example, an independent variable's odds ratio of 1.42 indicates that a one-unit increase in the variable's value increases the likelihood of the '1' outcome by 1.42 times. In other words, a unit change in the variable increases the odds of the outcome happening by 42%. In a similar fashion, odds ratios lower than one indicate that a one-unit increase in a variable's value decreases the odds of the outcome happening. As such, an odds ratio of 0.71, for example, indicates that the variable's unit increase decreases the odds of an outcome happening by 29%. Odds ratios are utilized as a way to infer the relative magnitude of an independent variable's influence (if statistically significant, of course). Finally, the second results table reports the overall percentage of cases classified correctly by each model along with an indication of the model's classification improvement over the null (i.e. constant-only) model (indicated as Correct classification Δ). The baseline reference for classification improvements is 54.2% (which is the original percentage of maintenance activity cases belonging to the outsourced to any degree '1' outcome state).

At this point, it would be prudent to address the reason why emphasis is put on the imputed dataset rather than the original in the context of the study's regression analyses. The argumentation is basically based on the concept of compound missing value levels previously reported in the chapter's missing value imputation section. Logistic regression necessitates the listwise deletion of observations in the presence of missing values anywhere in the range of a variable included in the regression model. At the same time, however, data in the original dataset is missing at random across the cases and across different variables. Thus, when sequential model building processes, such as the ones used here, include new variables in the equation, further cases are deleted due to the missing value profile of the new variables entered. Thus, the number of cases under consideration (i.e. the sample of observations used), diminishes fast and consequently the regression analysis's power and particulars deteriorate at the same rate. For example, upon sequentially including the first six variable blocks of efficiency-based considerations in a logistic regression, 36, 65, 95, 119, 146 and finally 169 cases are excluded respectively. Hence, it is witnessed that almost halfway through the process, virtually half the dataset is no longer being considered. Given the above, the issue is bypassed by using the study's imputed dataset to perform the analyses. This approach ensures that all of the cases remain under consideration while further allowing for a common baseline reference for classification improvements (in this case 54.2%, as mentioned above). Finally, even though regressions are reported for the imputed dataset only, the associated correlation matrices of both the original as well as the imputed datasets are offered for reference purposes.

9.5.1 Control variable hierarchical logistic regression

The control variables of the study include the concepts of firm size, firm age and firm average ship age. While the last two concepts are each operationalized through unique measures, the concept of firm size is associated with four relevant measures. Those include: the number of firm employees on shore, the number of firm employees at sea, the number of firm ships as well as the total DWT (deadweight tonnage) of firm ships. Given that all of the above measures of firm size try to capture the same underlying contstruct, high correaltions between them are expected. Table 9-29 presents the correlation matrix of the study's control variables in the inclusive 360 case original dataset (given that no missing values are present in the control variables, the study makes use of the original dataset as is).

Table 9-29. Control variable correlation matrix (360 case original dataset)

Variable	1	2	3	4	5	6
1 Firm size - Employees on shore (TRlog10)	1.000					
2 Firm size - Employees at sea (TRlog10)	.856 ***	1.000				
3 Firm size - Number of ships (TRlog10)	.893 ***	.927 ***	1.000			
4 Firm Size - Total DWT (TRlog10)	.843 ***	.841 ***	.865 ***	1.000		
5 Firm Age (TRsqrt)	.286 ***	.262 ***	.319 ***	.277 ***	1.000	
6 Average Ship Age (TRsqrt)	-.121 *	-.185 ***	-.162 **	-.236 ***	-.121 *	1.000

360 case original dataset. n=360. * p<.05; ** p<.01; *** p<.001

As anticipated, the correlation matrix reveals that all of the variables referring to firm size are indeed highly and significantly correlated with each other. So much so, in fact, that concerns for the presence of multicollinearity are raised. As such, it is decided that only one variable will be allowed to represent the concept in the regression model-building process. Standard logistic regression models were run for each indicator to assess each measure's predictive ability. Nevertheless, none of them produced significant results in the log-likelihood test. Resultingly, an arbitrarty decision to allow the measure of a firm's total DWT to represent the control construct is made for reference purposes. Tables 9-30 and 9-31 report the results of the hierarchical logistic regression model-building process of the study's control variables.

Table 9-30. Control variable logistic regression results: Coefficients (B)

		Model 1		Model 2		Model 3	
Variable	Hypoth.	Coef.	St.Er.	Coef.	St.Er.	Coef.	St.Er.
Intercept		.562	.990	.142	.273	.466	.352
Firm Size							
Firm size - Total DWT (TRlog10)	(±)	-.066	.165				
Firm Age							
Firm Age (TRsqrt)	(±)			.004	.042		
Firm Average Ship Age							
Average Ship Age (TRsqrt)	(±)					-.001	.001
Nagelkerke's R^2		.001		.000		.003	
Nagelkerke's ΔR^2		.001		.000		.003	
Chi-Square Δ (Block)		.161		.010		.799	

360 case original dataset. n=360. † p<.10; * p<.05; ** p<.01; *** p<.001

Table 9-31. Control variable logistic regression results: Odds ratios

		Model 1			Model 2			Model 3		
Variable	Hypoth.	Odds	Low	High	Odds	Low	High	Odds	Low	High
Intercept		1.754			1.154			1.594		
Firm Size										
Firm size - Total DWT (TRlog10)	(±)	.936	.677	1.294	1.004	.925	1.090	.999	.996	1.001
Firm Age										
Firm Age (TRsqrt)	(±)									
Firm Average Ship Age										
Average Ship Age (TRsqrt)	(±)									
Overall percentage classified correctly (%)		54.2			54.2			54.7		
Correct classification Δ (%)		0.0			0.0			0.5		

360 case original dataset. n=360. † p<.10; * p<.05; ** p<.01; *** p<.001

As evidenced in the results report tables, none of the study's control variables was found to significantly influence whether a maintenance activity is outsourced or not. Accordingly, no changes in classification performance were observed across the three models. As such, no control variables are included in the subsequent examination of the study's main independent variables.

9.5.2 Efficiency-based variable hierarchical logistic regression

Moving towards the examination of the study's main independent variables, efficiency-based considerations are explored next. With regard to the sequencing of efficiency-based considerations, the concern of behavioural uncertainty is entered first (as the building block of the opportunism assumption), followed then by the principals' asset specificity and proprietary asset exposure variables. Subsequently, the agents' asset specificity and proprietary asset exposure variables follow suite to conclude considerations dealing with the reciprocal exposure of assets. Afterwards, the framework's secondary discriminating attributes of volume uncertainty and technological uncertainty are entered, followed by the value assessment and contribution assessment concerns of the measurement perspective. Finally, the sequence is concluded by the consideration of transaction frequency. Tables 9-32 and 9-33 present the variable correlation matrices for the original and imputed 360 case datasets. Changes in correlation significance levels observed in the imputed dataset, even though consistently minute, are highlighted in Table 9-33. Tables 9-34 and 9-35, then report the results of the hierarchical logistic regression model-building process of the study's efficiency-based variables. Highlighted values in these tables denote statistically significant results.

Table 9-32. Efficiency-based variable correlation matrix (360 case original dataset)

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1 Principal's human asset specificity (TRsqrt)	1.000																			
2 Principal's physical asset specificity (TRsqrt)	.631 ***	1.000																		
3 Principal's dedicated asset specificity (TRsqrt)	.615 ***	.686 ***	1.000																	
4 Principal's procedural asset specificity (TRsqrt)	.758 ***	.776 ***	.664 ***	1.000																
5 Principal's temporal specificity (TRsqrtRflct)	.102	.037	.015	.035	1.000															
6 Principal's brand capital exposure (TRsqrtRflct)	.225 ***	.145 **	.111 *	.168 **	.521 ***	1.000														
7 Principal's proprietary info exposed (TRsqrt)	.346 ***	.220 ***	.348 ***	.222 ***	-.061	.115 *	1.000													
8 Agent's human asset specificity	.118 *	.138 *	.098	.186 **	.207 ***	.302 ***	.214 ***	1.000												
9 Agent's physical asset specificity	.068	.228 ***	.083	.216 ***	.167 **	.367 ***	.114	.717 ***	1.000											
10 Agent's dedicated asset specificity	.069	.037	.029	.104	.119 *	.271 ***	.096	.694 ***	.822 ***	1.000										
11 Agent's procedural asset specificity	.157 **	.207 ***	.070	.294 ***	.190 **	.348 ***	.166 **	.735 ***	.852 ***	.831 ***	1.000									
12 Agent's temporal asset specificity	-.046	-.217 ***	-.036	-.198 **	.232 ***	.135 *	.235 ***	.282 ***	.152 *	.291 ***	.201 **	1.000								
13 Agent's brand name capital exposure	.119	.027	.094	.047	.067	.003	.216 **	.285 ***	.363 ***	.298 ***	.390 ***	.407 ***	1.000							
14 Agent's proprietary info exposed (TRsqrt)	.302 ***	.195 **	.173 **	.222 ***	-.124 *	.073	.564 ***	.183 **	.191 **	.127 *	.188 **	.142 *	.176 **	1.000						
15 Behavioural uncertainty (unreliability)	-.106	-.085	-.176 **	-.038	-.029	.075	-.099	-.028	-.039	-.120 *	-.020	-.360 ***	-.105	.181 **	1.000					
16 Volume uncertainty (demand unpredictability)	.121 *	.120 *	.139 *	.130 *	.380 ***	.203 ***	.004	.093	.019	.045	.090	.220 ***	.106	-.005	-.083	1.000				
17 Technological Uncertainty (TRsqrt) (speed x unpr.)	.280 ***	.109	.155 **	.130 *	.232 ***	.194 **	.190 **	.154 *	.158 *	.169 **	.225 ***	.153 *	.247 ***	.160 **	-.170 **	.155 **	1.000			
18 Value assessment ability (pricing ease)	-.226 ***	-.114 *	-.314 ***	-.189 **	-.255 ***	-.081	-.032	-.096	-.113	-.227 ***	-.139 *	-.289 ***	-.196 **	-.037	.160 **	-.562 ***	-.254 ***	1.000		
19 Contribution assessment ability (evaluation ease)	-.546 ***	-.375 ***	-.538 ***	-.473 ***	-.111	-.011	-.246 ***	.006	.017	-.027	-.073	-.076	-.085	-.305 ***	.215 ***	-.111	-.312 ***	.290 ***	1.000	
20 Transaction Frequency	-.034	-.012	-.063	.039	.108 *	.148 **	-.083	.029	-.051	.073	-.013	.062	-.176 **	-.117 *	-.108	.041	.073	-.017	.078	1.000

360 case original dataset. n=360. * p<.05; ** p<.01; *** p<.001

Table 9-33. Efficiency-based variable correlation matrix (360 case imputed dataset)

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1 Principal's human asset specificity (TRsqrt)	1.000																			
2 Principal's physical asset specificity (TRsqrt)	.578 ***	1.000																		
3 Principal's dedicated asset specificity (TRsqrt)	.544 ***	.622 ***	1.000																	
4 Principal's procedural asset specificity (TRsqrt)	.709 ***	.710 ***	.610 ***	1.000																
5 Principal's temporal specificity (TRsqrtRflct)	.049	.013	.022	.010	1.000															
6 Principal's brand capital exposure (TRsqrtRflct)	.168 **	.101	.086	.135 *	.500 ***	1.000														
7 Principal's proprietary info exposed (TRsqrt)	.288 ***	.190 ***	.283 ***	.198 ***	-.017	.115 *	1.000													
8 Agent's human asset specificity	.100	.128 *	.120 *	.149 **	.214 ***	.292 ***	.192 ***	1.000												
9 Agent's physical asset specificity	.083	.175 **	.088	.165 **	.173 **	.315 ***	.090	.663 ***	1.000											
10 Agent's dedicated asset specificity	.066	.017	.044	.089	.137 **	.269 ***	.116 *	.616 ***	.739 ***	1.000										
11 Agent's procedural asset specificity	.121 *	.158 **	.073	.241 ***	.189 ***	.291 ***	.137 **	.663 ***	.770 ***	.748 ***	1.000									
12 Agent's temporal asset specificity	.009	-.160 **	-.030	-.111 *	.204 ***	.133 *	.170 **	.219 ***	.143 **	.276 ***	.197 ***	1.000								
13 Agent's brand name capital exposure	.060	.009	.068	.026	.036	-.056	.150 **	.198 ***	.218 ***	.177 **	.253 ***	.221 ***	1.000							
14 Agent's proprietary info exposed (TRsqrt)	.252 ***	.179 **	.174 **	.179 **	-.125 *	.083	.485 ***	.195 ***	.132 *	.102	.161 **	.100	.111 *	1.000						
15 Behavioural uncertainty (unreliability)	-.082	-.054	-.132 *	-.075	-.042	.051	-.083	-.027	-.021	-.122 *	-.019	-.240 ***	-.083	.131 *	1.000					
16 Volume uncertainty (demand unpredictability)	.074	.071	.069	.080	.345 ***	.210 ***	.000	.094	.085	.065	.110 *	.173 **	.078	-.034	-.045	1.000				
17 Technological Uncertainty (TRsqrt) (speed x unpr.)	.212 ***	.079	.093	.120 *	.174 **	.169 **	.112 *	.113 *	.155 **	.202 ***	.224 ***	.130 *	.201 ***	.072	-.144 **	.117 *	1.000			
18 Value assessment ability (pricing ease)	-.201 ***	-.109 *	-.255 ***	-.154 **	-.238 ***	-.066	-.050	-.096	-.088	-.189 ***	-.123 *	-.255 ***	-.097	.004	.144 **	-.476 ***	-.204 ***	1.000		
19 Contribution assessment ability (evaluation ease)	-.405 ***	-.311 ***	-.432 ***	-.390 ***	-.111 *	-.032	-.156 **	-.070	-.029	-.071	-.065	-.092	-.091	-.302 ***	.208 ***	-.089	-.218 ***	.283 ***	1.000	
20 Transaction Frequency	-.040	-.033	-.059	.040	.097	.147 **	-.054	.032	-.063	.039	.000	.005	-.138 **	-.058	-.110 *	.049	.064	-.010	.055	1.000

360 case imputed dataset. n=360. * p<.05; ** p<.01; *** p<.001

Table 9-34. Efficiency-based variable logistic regression results: Coefficients (B) (Imputed dataset)

		Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7		Model 8		Model 9		**Model 10a**		**Model 10b**	
Variable	Hypoth.	Coef.	St.Er.	Coef.	St.Er.	Coef.	St.Er.	Coef.	St.Er.	Coef.	St.Er.	Coef.	St.Er.	Coef.	St.Er.	Coef.	St.Er.	Coef.	St.Er.	**Coef.**	**St.Er.**	**Coef.**	**St.Er.**
Intercept		.050	.264	-.899 *	.390	-.920 *	.457	-.710	.463	-1.855 **	.561	-2.188 ***	.583	-2.702 ***	.650	-2.098 *	.857	-1.093	1.020	-0.606	1.052	-2.176 **	.688
Behavioural Uncertainty	H_{TCE1} (-)																						
Unreliability of suppliers	(-)	.046	.096																				
Principal's Asset Specificity	H_{TCE2} (-)																						
Principal's human asset specificity (TRsqrt)	(-)			.219	.266	.215	.271	.273	.277	.119	.273	.126	.283	.043	.288	.018	.288	-.018	.294	-.074	.300	-.017	.294
Principal's physical asset specificity (TRsqrt)	(-)			-.391	.292	-.391	.292	-.532 †	.309	-.405	.297	-.452	.305	-.448	.307	-.420	.308	-.383	.308	-.416	.310	-.476	.309
Principal's dedicated asset specificity (TRsqrt)	(-)			-.063	.264	-.064	.267	-.012	.273	-.101	.268	-.126	.274	-.120	.276	-.186	.283	-.275	.292	-.308	.296	-.156	.280
Principal's procedural asset specificity (TRsqrt)	(-)			.553 †	.326	.553 †	.326	.566 †	.341	.591 †	.330	.562 †	.338	.582 †	.342	.590 †	.342	.508	.344	.603 †	.351	.674 †	.348
Principal's temporal specificity (TRsqrtRflct)	(+)			.388 *	.182	.379 †	.211	.369 †	.192	.431 *	.185	.132	.201	.074	.204	.061	.205	.036	.205	.070	.206	.112	.205
Principal's Proprietary Asset Exposure	H_{TCE3} (-)																						
Principal's brand capital exposure (TRsqrtRflct)	(+)					.018	.208																
Principal's proprietary info exposed (TRsqrt)	(-)					.010	.218																
Agent's Asset Specificity	H_{TCE4} (+)																						
Agent's human asset specificity	(+)							-.032	.094														
Agent's physical asset specificity	(+)							.182	.120														
Agent's dedicated asset specificity	(+)							-.313 *	.124														
Agent's procedural asset specificity	(+)							.083	.131														
Agent's temporal asset specificity	(+)							.048	.058														
Agent's Proprietary Assest Exposure	H_{TCE5} (+)																						
Agent's brand name capital exposure	(+)									.111	.079	.089	.082	.063	.083	.061	.083	.064	.084	.037	.085	.034	.085
Agent's proprietary info exposed (TRsqrt)	(+)									.436 †	.236	.484 *	.245	.476 †	.247	.487 *	.247	.359	.254	.358	.256	.471 †	.249
Volume Uncertainty	H_{TCE6} (-)																						
Difficulty to predict demand volume	(-)											.339 ***	.075	.337 ***	.075	.303 ***	.081	.340 ***	.076	.348 ***	.077	.345 ***	.076
Technological Uncertainty	H_{TCE7} (-)																						
Speed x unpredictability of tech. devel. (TRsqrt)	(-)													.258 *	.132	.244 †	.133	.220 †	.134	.243 †	.136	.282 *	.134
Value Assessment Ability	H_{TCE8} (+)																						
Ease of pricing tasks in the activity	(+)															-.100	.093						
Contribution Assessment Ability	H_{TCE9} (+)																						
Ease of supplier performance evaluation	(+)																	-.206 *	.101	-.202 *	.103		
Transaction Frequency	H_{TCE10} (-)																						
Frequency of utilizing the transaction	(-)																			-.130 *	.064	-.133 *	.063
Nagelkerke's R^2		.001		.044		.044		.070		.065		.142		.154		.158		.168		.182		.169	
Nagelkerke's ΔR^2		.001		.044		.000		.026		.021		.077		.012		.004		.014		.014		.001	
Chi-Square Δ (Block)		.233		11.942 *		.010		7.477		6.117 *		22.282 ***		3.880 *		1.155		4.209 *		4.206 *		4.459 *	

360 case original dataset. n=360. † p<.10; * p<.05; ** p<.01; *** p<.001

Table 9-35. Efficiency-based variable logistic regression results: Odds ratios (Imputed dataset)

		Model 1			Model 2			Model 3			Model 4			Model 5			Model 6			Model 7			Model 8			Model 9			**Model 10a**			**Model 10b**		
Variable	Hypoth.	Odds	Low	High	Odds	Low	High	Odds	Low	High	Odds	Low	High	Odds	Low	High	Odds	Low	High	Odds	Low	High	Odds	Low	High	Odds	Low	High	**Odds**	**Low**	**High**	**Odds**	**Low**	**High**
Intercept		1.052			.407			.398			.491			.156			.112			.067			.123			.335			.545			.113		
Behavioural Uncertainty	H_{TCE1} (-)																																	
Unreliability of suppliers	(-)	1.047	.867	1.265																														
Principal's Asset Specificity	H_{TCE2} (-)																																	
Principal's human asset specificity (TRsqrt)	(-)				1.245	.739	2.097	1.240	.729	2.108	1.314	.764	2.260	1.126	.659	1.924	1.135	.652	1.975	1.044	.594	1.835	1.018	.579	1.792	.982	.552	1.748	.929	.516	1.674	.983	.552	1.750
Principal's physical asset specificity (TRsqrt)	(-)				.676	.382	1.198	.676	.382	1.199	.587	.320	1.076	.667	.373	1.193	.636	.350	1.157	.639	.350	1.165	.657	.360	1.201	.682	.373	1.246	.660	.359	1.212	.621	.339	1.138
Principal's dedicated asset specificity (TRsqrt)	(-)				.939	.560	1.574	.938	.556	1.582	.988	.579	1.686	.904	.535	1.526	.882	.515	1.509	.887	.516	1.522	.830	.476	1.446	.759	.429	1.345	.735	.412	1.312	.856	.495	1.481
Principal's procedural asset specificity (TRsqrt)	(-)				1.739	.919	3.292	1.738	.917	3.296	1.761	.903	3.433	1.806	.945	3.450	1.755	.905	3.402	1.789	.916	3.494	1.804	.923	3.526	1.661	.846	3.261	1.827	.919	3.635	1.962	.993	3.879
Principal's temporal specificity (TRsqrtRflct)	(+)				1.474	1.033	2.104	1.461	.966	2.209	1.447	.993	2.108	1.539	1.072	2.212	1.141	.770	1.692	1.077	.722	1.606	1.063	.712	1.587	1.036	.693	1.549	1.072	.716	1.607	1.118	.748	1.671
Principal's Proprietary Asset Exposure	H_{TCE3} (-)																																	
Principal's brand capital exposure (TRsqrtRflct)	(+)							1.018	.677	1.531																								
Principal's proprietary info exposed (TRsqrt)	(-)							1.010	.659	1.549																								
Agent's Asset Specificity	H_{TCE4} (+)																																	
Agent's human asset specificity	(+)										.968	.806	1.163																					
Agent's physical asset specificity	(+)										1.199	.948	1.518																					
Agent's dedicated asset specificity	(+)										.731	.573	.933																					
Agent's procedural asset specificity	(+)										1.086	.841	1.403																					
Agent's temporal asset specificity	(+)										1.049	.937	1.176																					
Agent's Proprietary Assest Exposure	H_{TCE5} (+)																																	
Agent's brand name capital exposure	(+)													1.118	.958	1.305	1.094	.932	1.283	1.065	.904	1.253	1.063	.902	1.252	1.066	.904	1.256	1.038	.878	1.227	1.035	.876	1.222
Agent's proprietary info exposed (TRsqrt)	(+)													1.547	.974	2.457	1.623	1.004	2.623	1.610	.993	2.611	1.628	1.003	2.641	1.432	.870	2.355	1.431	.866	2.365	1.602	.982	2.611
Volume Uncertainty	H_{TCE6} (-)																																	
Difficulty to predict demand volume	(-)																1.403	1.211	1.625	1.401	1.209	1.624	1.353	1.154	1.588	1.404	1.211	1.629	1.416	1.218	1.647	1.412	1.216	1.640
Technological Uncertainty	H_{TCE7} (-)																																	
Speed x unpredictability of tech. devel. (TRsqrt)	(-)																			1.294	.999	1.676	1.276	.983	1.657	1.246	.958	1.619	1.275	.977	1.665	1.326	1.019	1.725
Value Assessment Ability	H_{TCE8} (+)																																	
Ease of pricing tasks in the activity	(+)																						.905	.754	1.086									
Contribution Assessment Ability	H_{TCE9} (+)																																	
Ease of supplier performance evaluation	(+)																									.814	.668	.993	.817	.668	.999			
Transaction Frequency	H_{TCE10} (-)																																	
Frequency of utilizing the transaction	(-)																												.878	.775	.995	.876	.774	.991
Overall percentage classified correctly (%)		54.2			57.2			57.2			61.4			60.3			61.1			64.2			61.9			63.3			65.3			65.3		
Correct classification Δ (%)		.0			3.0			.0			4.2			3.1			.8			3.1			-2.3			-.9			2.0			2.0		

360 case imputed dataset. n=360. † p<.10; * p<.05; ** p<.01; *** p<.001

The results tables reveal a number of interesting findings. First of all, Model 1, indicates that behavioural uncertainty (as operationalized through the perceived unreliability of maintenance suppliers) bears no influence on whether a maintenance activity is outsourced or not. Model 2, then indicates that activities are more likely to be outsourced, the higher the principals' procedural specificity is and the lower the principals' temporal specificity is (note that the latter variable is reflected). The finding is significant at the .05 level in the case of temporal specificity and at the .10 level in the case of procedural asset specificity. Afterwards, model 3 indicates that the exposure of principals' proprietary assets has no say in the sourcing status of a maintenance activity. Moving on then, Model 4 provides some limited indications that the higher the agents' dedicated asset specificity is the less likely a maintenance activity is to be outsourced. While the regression coefficient for this variable is found significant at the .05 level, the variables block's or even the single variable's entrance in the equation did not produce significant changes in model fit. As such, the variables were excluded from further model runs.

Subsequently, Model 5 indicates that the higher agent's proprietary information exposure is, the more likely a maintenance activity is to be outsourced. The finding is significant at the .10 level (sig. .065) while further producing significant changes at the .05 level in model fit. The model's correct classification rate reached 60.3%, marking a total change of 6.1% from the baseline and 3.1% from the previous significant model that included the principal's asset specifcity variables only. Moving on then, Model 6 indicates that the higher volume uncertainty on behalf of principals is, the more likely an activity is to be outsourced with the particular outcome being on average 40% more likely with every perceptual unit increase in this particular type of uncertainty. The finding is significant at the .001 level. In a similar fashion, though at a lower significance level, Model 7 indicates that the higher technological uncertainy on behalf of principals is, again the more likely a maintenance activity is to be outsourced. The finding is significant at the .05 level in terms of both coefficient as well as model fit improvement significance. Afterwards, Model 8 indicates that the principals' value assessment ability bears no influence on an activity's sourcing status as no significant results were detected.

Model 9, examines the impact of principals' contribution assessment ability. The finding, significant at the .05 level, indicates that the higher the contribution assessment ability, the less likely an activity is to be outsourced (with chances of outsourcing reduced by an average of 19% with every unit increase of this ability). Interestingly, with this variable's entrance in the regression model a number of previously significant results in the principals' asset specificity and the agents' proprietary asset exposure variable blocks are rendered insignificant. As such, in the interest of inquisitiveness two final tenth models were produced. Model 10a that includes the contribution asessment variable along with the further examination of transaction frequency, and Model 10b that excludes the particular variable and examines transaction frequency in light of the rest of the previously significant variables. As witnessed in the reports tables, in both cases transaction frequency is found to significantly affect an activity's sourcing state (at the .05 level). In particular, the higher an activity's frequency of use is the less likely that activity is to be outsourced. The exclusion of the contribution assessment ability variable in Model 10b, finally, restored the significant status of the previously affected variables indicating the presence of certain interaction effects that neverthelss fall outside the scope of this statistical analysis.

9.5.3 Dependency-based variable hierarchical logistic regression

Continuing the exploration of the study's main independent variables, focus is put on dependency-based considerations. With regard to the sequencing of said considerations, the proxy of power imbalance identified as the principal's general dependence on agents (with all of the associated caveats firmly recognized) is entered first. Subsequently, concerns of unilateral and bilateral power restructuring operations are entered in the equation in the guise of the principals' resource internalization potential difficulty and cooptation potential ability variables. Finally, the sequence is concluded by the consideration of the agents' actual dependence on principals (operationalized through the principals' input to agents' circle of operations). Tables 9-36 and 9-37 present the variable correlation matrices for the original and imputed 360 case datasets. Changes in correlation significance levels observed in the imputed dataset, are highlighted in Table 9-37.

Table 9-36. Dependency-based variable correlation matrix (360 case original dataset)

Variable	1	2	3	4
1 Principal's dependence on agents (TRlog10)	1.000			
2 Resource internal. potential (difficulty) (TRsqrt)	-.087	1.000		
3 Cooptation potential	.159 *	.311 ***	1.000	
4 Principal's input to agent business (TRsqrt)	.016	.177 *	.591 ***	1.000

360 case original dataset. n=360. * p<.05; ** p<.01; *** p<.001

Table 9-37. Dependency-based variable correlation matrix (360 case imputed dataset)

Variable	1	2	3	4
1 Principal's dependence on agents (TRlog10)	1.000			
2 Resource internal. potential (difficulty) (TRsqrt)	-.045	1.000		
3 Cooptation potential	.155 **	.275 ***	1.000	
4 Principal's input to agent business (TRsqrt)	.001	.081	.274 ***	1.000

360 case imputed dataset. n=360. * p<.05; ** p<.01; *** p<.001

Tables 9-38 and 9-39, then report the results of the hierarchical logistic regression model-building process of the study's dependency-based variables. Highlighted values in these tables denote statistically significant results.

Table 9-38. Dependency-based variable logistic regression results: Coefficients (B) (Imputed dataset)

		Model 1		**Model 2**		Model 3		Model 4	
Variable	Hypoth.	Coef.	St.Er.	**Coef.**	**St.Er.**	Coef.	St.Er.	Coef.	St.Er.
Intercept		.189	.121	-.546 †	.289	-.619 *	.316	-.486	.308
Power Imbalance (proxy)	H_{RDT1} (+)								
Principal's dependence on agents (TRlog10)	(-)	.062	.169						
Unilateral Power Restructuring Operations	H_{RDT2} (+)								
Resource internal. potential (difficulty) (TRsqrt)	(-)			.481 **	.182	.452 *	.189	.490 **	.183
Bilateral Power Restructuring Operations	H_{RDT3} (+)								
Cooptation potential	(+)					.040	.069		
Agent Actual Dependence	H_{RDT4} (+)								
Principal's input to agent business (TRsqrt)	(+)							-.033	.060
Nagelkerke's R^2		.000		.026		.028		.028	
Nagelkerke's ΔR^2		.000		.026		.002		.002	
Chi-Square Δ (Block)		.135		7.183 **		.332		.305	

360 case Imputed dataset. n=360. † p<.10; * p<.05; ** p<.01; *** p<.001

Table 9-39. Dependency-based variable logistic regression results: Odds ratios (Imputed dataset)

		Model 1			**Model 2**			Model 3			Model 4		
Variable	Hypoth.	Odds	Low	High	**Odds**	**Low**	**High**	Odds	Low	High	Odds	Low	High
Intercept		1.207			.579			.538			.615		
Power Imbalance (proxy)	H_{RDT1} (+)												
Principal's dependence on agents (TRlog10)	(-)	1.064	.764	1.810									
Unilateral Power Restructuring Operations	H_{RDT2} (+)												
Resource internal. potential (difficulty) (TRsqrt)	(-)				1.618	1.133	2.311	1.571	1.085	2.274	1.632	1.141	2.334
Bilateral Power Restructuring Operations	H_{RDT3} (+)												
Cooptation potential	(+)							1.041	.909	1.191			
Agent Actual Dependence	H_{RDT4} (+)												
Principal's input to agent business (TRsqrt)	(+)										.968	.861	1.088
Overall percentage classified correctly (%)		54.2			53.9			55.0			53.3		
Correct classification Δ (%)		.0			-.3			1.1			-.6		

360 case imputed dataset. n=360. † p<.10; * p<.05; ** p<.01; *** p<.001

Model 1, indicates that the principal's general dependence on agents (as specified through resource-dependency theory, at least) does not significantly influence a maintenance activity's sourcing status. Further, Model 2 indicates that the more difficult principals find it to internally develop a maintenance activity, the more likely that activity is to be outsourced. The finding is significant at the .01 level. Subsequently, Models 3 and 4 indicate that principals' cooptation potential and agents' actual dependence on principals bear no influence on a maintenance activity's sourcing status. As such, the parsimonious model of dependency-based considerations in this analysis is Model 2 (indicated by the bolded headings).

9.5.4 Competence-based variable hierarchical logistic regression

Competence-based considerations are examined next. With regard to the entrance sequencing of these considerations, the conceptual rationale of the resource-based view theory is reflected. As such, resource value considerations are entered first followed by the novel but closely associated concept of potential resource value. Subsequently, the natural resource scarcity consideration (operationalized as the difficulty in recruiting experienced maintenance personnel) is examined. Finally, the sequence is concluded by the consideration of resource inimitability concerns (including intrafirm and interfirm causal ambiguity as well as resource social complexity). Tables 9-40 and 9-41 present the variable correlation matrices for the original and imputed 360 case datasets. Changes in correlation significance levels observed in the imputed dataset, are highlighted in Table 9-41. Tables 9-42 and 9-43, then report the results of the hierarchical logistic regression model-building process of the study's competence-based variables. Highlighted values in these tables denote statistically significant results.

Table 9-40. Competence-based variable correlation matrix (360 case original dataset)

	Variable	1	2	3	4	5	6	7
1	Contribution to higher gains	1.000						
2	Contribution to lower costs	.436 ***	1.000					
3	Potential resource value	.801 ***	.701 ***	1.000				
4	Natural resource scarcity	.003	.032	.066	1.000			
5	Intrafirm causal ambiguity	-.037	.060	.024	.190 **	1.000		
6	Interfirm causal ambiguity	.226 ***	.318 ***	.235 ***	.335 ***	-.175 **	1.000	
7	Resource social complexity (TRsqrt)	-.143 *	-.075	-.144 *	.030	-.079	.027	1.000

360 case original dataset. n=360. * p<.05; ** p<.01; *** p<.001

Table 9-41. Competence-based variable correlation matrix (360 case imputed dataset)

Variable	1	2	3	4	5	6	7
1 Contribution to higher gains	1.000						
2 Contribution to lower costs	.406 ***	1.000					
3 Potential resource value	.715 ***	.619 ***	1.000				
4 Natural resource scarcity	.010	.007	.005	1.000			
5 Intrafirm causal ambiguity	-.029	.057	.000	.108 **	1.000		
6 Interfirm causal ambiguity	.243 ***	.304 ***	.195 ***	.290 ***	-.179 **	1.000	
7 Resource social complexity (TRsqrt)	-.095	-.071	-.122 *	.009	-.131 *	.053	1.000

360 case imputed dataset. n=360. * p<.05; ** p<.01; *** p<.001

Table 9-42. Competence-based variable logistic regression results: Coefficients (B) (Imputed dataset)

		Model 1		Model 2		Model 3		Model 4		**Model 5**	
Variable	Hypoth.	Coef.	St.Er.	Coef.	St.Er.	Coef.	St.Er.	Coef.	St.Er.	**Coef.**	**St.Er.**
Intercept		-.347	.261	-.200	.298	-.368	.275	-1.306 ***	.352	-3.312 ***	.714
Resource Value I	H_{RBV1} (-)										
Contribution to higher gains	(-)	.072 *	.034	.088 *	.037	.063	.048	.074 *	.035	.079 *	.037
Resource Value II	H_{RBV2} (-)										
Contribution to lower costs	(-)			-.071	.069						
Potential Resource Value	H_{RBV3} (-)										
Potential contribution to gains or costs	(-)					.014	.053				
Natural Resource Scarcity	H_{RBV4} (-)										
Difficulty of recruitment	(-)							.304 ***	.071	.272 ***	.075
Resource Inimitability	H_{RBV5} (-)										
Intrafirm causal ambiguity	(-)									.144 **	.047
Interfirm causal ambiguity	(-)									.068	.082
Resource social complexity (TRsqrt)	(-)									.288 *	.137
Nagelkerke's R^2		.017		.053		.017		.088		.132	
Nagelkerke's Δ R^2		.017		.036		.000		.071		.044	
Chi-Square Δ (Block)		4.655 *		1.061		.066		19.808 ***		12.830 **	

360 case Imputed dataset. n=360. † p<.10; * p<.05; ** p<.01; *** p<.001

Table 9-43. Competence-based variable logistic regression results: Odds ratios (Imputed dataset)

		Model 1			Model 2			Model 3			Model 4			**Model 5**		
Variable	Hypoth.	Odds	Low	High	Odds	Low	High	Odds	Low	High	Odds	Low	High	**Odds**	**Low**	**High**
Intercept		.707			.819			.692			.271			.036		
Resource Value I	H_{RBV1} (-)															
Contribution to higher gains	(-)	1.075	1.006	1.148	1.092	1.015	1.174	1.065	.970	1.171	1.077	1.006	1.153	1.082	1.007	1.163
Resource Value II	H_{RBV2} (-)															
Contribution to lower costs	(-)				.932	.814	1.067									
Potential Resource Value	H_{RBV3} (-)															
Potential contribution to gains or costs	(-)							1.014	.913	1.125						
Natural Resource Scarcity	H_{RBV4} (-)															
Difficulty of recruitment	(-)										1.355	1.180	1.556	1.313	1.132	1.522
Resource Inimitability	H_{RBV5} (-)															
Intrafirm causal ambiguity	(-)													1.155	1.052	1.268
Interfirm causal ambiguity	(-)													1.070	.911	1.256
Resource social complexity (TRsqrt)	(-)													1.334	1.020	1.745
Overall percentage classified correctly (%)		54.7			52.5			55.0			61.9			63.6		
Correct classification Δ (%)		.5			-2.2			.3			7.2			1.7		

360 case imputed dataset. n=360. † p<.10; * p<.05; ** p<.01; *** p<.001

Model 1 indicates that as an activity's contribution to higher gains increases the more likely the activity is to be outsourced. While the finding is significant at the .05 level, the average effect of the variable (as indicated by its associated odds ratio) is relatively small while at the same time offering marginal classification improvements (Δ 0.5%). Models 2 and 3 respectively indicate that resource value in terms of contribution to lower costs as well as potential resource value as future contributions to higher gains or lower costs do not influence an activity's sourcing status. In contrast, Model 4 indicates that as natural resource scarcity for an activity increases, the more likely it is to be outsourced. The finding is significant at the .001 level and further presents one of the highest single variable improvements in Nagelkerke's R^2 by uniquely explaining a total of 7.1%

of the pseudo-variance present in the dependent outcome (a similar occurrence is observed in the already covered case of the efficiency consideration of volume uncertainty). Model 5, finally, indicates that as intrafirm causal ambiguity (operationalized as the composite sum of an activity's complexity, tacitness and distance to performance) increases, the more likely the activity is to be outsourced. The particular finding is significant at the .01 level. The same model further indicates that as an activity's social complexity (operationalized by the number of employees assigned to each activity) increases, again the more likely the activity is to be outsourced. This last finding, that is significant at the .05 level, is certainly one of the more interesting ones even outside the rationale of competence-based arguments. Given the above, Model 5 is retained as the parsimonious model of competence-based considerations in this regression technique. Interestingly, the particular model offers a correct classification rate of 63.6% (marking an overall improvement of 9.4% over the baseline) that closely rivals the one offered by the more variable endowed parsimonious model of efficiency-based considerations (offering an overall improvement of 11.1%)

9.5.5 Identity-based variable hierarchical logistic regression

Identity-based considerations conclude the partitioned exploration of strategic perspectives through logistic regression analyses. With regard to the entrance sequencing of these considerations, the construct of resource-identity coherence is entered first as the only principle hypothesis of this strategic perspective. Sourcing influences imposed by the empirical context's institutional forces are entered next while the sequence is concluded by the consideration of sourcing influences deriving from competitive industrial forces. Tables 9-44 and 9-45 present the variable correlation matrices for the original and imputed 360 case datasets (in this case only a few data points of the resource-identity coherence variable are imputed).

Table 9-44. Identity-based variable correlation matrix (360 case original dataset)

Variable		1	2	3
1	Resource-identity coherence	1.000		
2	Institutional forces influence	.366 ***	1.000	
3	Industrial forces influence	.307 ***	.447 ***	1.000

360 case original dataset. n=360. * p<.05; ** p<.01; *** p<.001

Table 9-45. Identity-based variable correlation matrix (360 case imputed dataset)

Variable		1	2	3
1	Resource-identity coherence	1.000		
2	Institutional forces influence	.364 ***	1.000	
3	Industrial forces influence	.307 ***	.447 ***	1.000

360 case imputed dataset. n=360. * p<.05; ** p<.01; *** p<.001

Tables 9-46 and 9-47, then report the results of the hierarchical logistic regression model-building process of the study's identity-based variables. Highlighted values in these tables would normally denote statistically significant results. Nevertheless, as witnessed in said tables, none of the variables examined yielded statistically significant results. Of perhaps limited interest (at least statistically) is the fact that as an activity is more aligned with a principal's (i.e. shipping firm's) organizational identity the less likely the activity is to be outsourced (sig. .255).

Table 9-46. Identity-based variable logistic regression results: Coefficients (B) (Imputed dataset)

		Model 1		Model 2		Model 3	
Variable	Hypoth.	Coef.	St.Er.	Coef.	St.Er.	Coef.	St.Er.
Intercept		.729	.505	.505	.491	.241	.265
Resouce-Identity Coherence	H_{OIC1} (-)						
Alignment of activity with identity	(-)	-.111	.098				
Institutional Forces Influence	H_{OIC2} (±)						
Institutional forces degree of infuence	(±)			-.066	.093		
Industrial Forces Influence	H_{OIC3} (±)						
Indutrial forces degree of infuence	(±)					-.022	.071
Nagelkerke's R^2		.005		.002		.000	
Nagelkerke's ΔR^2		.005		.002		.000	
Chi-Square Δ (Block)		1.306		.500		.094	

360 case original dataset. n=360. † p<.10; * p<.05; ** p<.01; *** p<.001

Table 9-47. Identity-based variable logistic regr. results: Odds ratios (Imputed dataset)

		Model 1			Model 2			Model 3		
Variable	Hypoth.	Odds	Low	High	Odds	Low	High	Odds	Low	High
Intercept		2.072			1.657			1.273		
Resouce-Identity Coherence	H_{OIC1} (-)									
Alignment of activity with identity	(-)	.895	.738	1.084						
Institutional Forces Influence	H_{OIC2} (±)									
Institutional forces degree of infuence	(±)				.937	.781	1.123			
Industrial Forces Influence	H_{OIC3} (±)									
Indutrial forces degree of infuence	(±)							.978	.851	1.125
Overall percentage classified correctly (%)		56.1			54.2			54.2		
Correct classification Δ (%)		1.9			.0			.0		

360 case imputed dataset. n=360. † p<.10; * p<.05; ** p<.01; *** p<.001

9.5.6 A multi-theoretic approach through logistic regression analysis

In concluding this section presenting the results of hierarchical logistic regression analyses, a multi-theoretic approach is offered by the examination of a number of models where the various perspectives' statistically significant findings are combined. In essence, this meta-analysis aims at investigating whether such a multi-theoretic or combined-perspective approach to the explanation of maintenance activity sourcing states yields superior results when compared to the consideration of each perspective individually.

As such, the variables of principals' asset specificity concerns and agents' proprietary asset exposure issues along with the variables of volume uncertainty, technological uncertainty, contribution assessment ability, transaction frequency, resource internalization potential, resource value (through contribution to higher gains) and resource inimitability are combined in three standard logistic regression models. The first includes all of the variables while the second excludes the potentially disturbing (in a statistical sense) variable of contribution assessment ability. The third model finally aims at the formation of the most economical model possible, and thus further excludes statistically non-significant component variables of the principals' asset specificity, the agents' proprietary asset exposure and resource inimitability concerns. Table 9-48 presents the assorted variables' correlation matrix in the 360 case imputed dataset. Tables 9-49 and 9-50 then report on the results of the scheduled standard logistic regression analyses.

Table 9-48. Multi-theoretic variable correlation matrix (360 case imputed dataset)

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1 Principal's human asset specificity (TRsqrt)	1.000																
2 Principal's physical asset specificity (TRsqrt)	.578 ***	1.000															
3 Principal's dedicated asset specificity (TRsqrt)	.544 ***	.622 ***	1.000														
4 Principal's procedural asset specificity (TRsqrt)	.709 ***	.710 ***	.610 ***	1.000													
5 Principal's temporal specificity (TRsqrtRflct)	.049	.013	.022	.010	1.000												
6 Agent's brand name capital exposure	.060	.009	.068	.026	.036	1.000											
7 Agent's proprietary info exposed (TRsqrt)	.252 ***	.179 **	.174 **	.179 **	-.125 *	.111 *	1.000										
8 Volume uncertainty (demand unpredictability)	.074	.071	.069	.080	.345 ***	.078	-.034	1.000									
9 Technological Uncertainty (TRsqrt) (speed x unpr.)	.212 ***	.079	.093	.120 *	.174 **	.201 ***	.072	.117 *	1.000								
10 Contribution assessment ability (evaluation ease)	-.405 ***	-.311 ***	-.432 ***	-.390 ***	-.111 *	-.091	-.302 ***	-.089	-.218 ***	1.000							
11 Transaction Frequency	-.040	-.033	-.059	.040	.097	-.138 **	-.058	.049	.064	.055	1.000						
12 Resource internal. potential (difficulty) (TRsqrt)	.423 ***	.395 ***	.384 ***	.392 ***	.074	.124 *	.097	.215 ***	.059	-.318 ***	-.007	1.000					
13 Contribution to higher gains	.183 ***	.160 **	.318 ***	.148 **	-.108 *	.335 ***	.142 **	-.034	.182 **	-.200 ***	-.046	.198 ***	1.000				
14 Natural resource scarcity	.156 **	.016	.124 *	.133 *	.255 ***	.219 ***	-.077	.353 ***	.240 ***	-.124 *	.070	.168 **	.012	1.000			
15 Intrafirm causal ambiguity	.064	.027	.051	.093	-.139 **	.001	.019	.126 *	.072	-.121 *	-.216 ***	.108 *	-.029	.108 *	1.000		
16 Interfirm causal ambiguity	.249 ***	.200 ***	.147 **	.233 ***	.316 ***	.137 **	.111 *	.130 *	.164 **	-.190 ***	.009	.097	.243 ***	.290 ***	-.179 **	1.000	
17 Resource social complexity (TRsqrt)	.029	.107 *	-.039	.022	.075	-.086	.214 ***	-.030	.035	.029	.182 **	-.055	-.095	.009	-.131 *	.053	1.000

360 case imputed dataset. n=360. * p<.05; ** p<.01; *** p<.001

Table 9-49. Multi-theoretic logistic regression results: Coefficients (B) (Imputed dataset)

		Model 1		Model 2		Model 3	
Variable	Hypoth.	Coef.	St.Er.	Coef.	St.Er.	Coef.	St.Er.
Intercept		-2.588 *	1.300	-4.128 ***	.970	-4.197 ***	.930
Principal's Asset Specificity	H_{TCE2}(-)						
Principal's human asset specificity (TRsqrt)	(-)	-.182	.309	-.153	.306	-	-
Principal's physical asset specificity (TRsqrt)	(-)	-.423	.332	-.474	.330	-.627 *	.308
Principal's dedicated asset specificity (TRsqrt)	(-)	-.511	.323	-.383	.308	-	-
Principal's procedural asset specificity (TRsqrt)	(-)	.617 †	.359	.674 †	.359	.492 †	.300
Principal's temporal specificity (TRsqrtRflct)	(+)	.143	.234	.195	.232	.158	.220
Agent's Proprietary Assest Exposure	H_{TCE5}(+)						
Agent's brand name capital exposure	(+)	-.058	.097	-.067	.096	-	-
Agent's proprietary info exposed (TRsqrt)	(+)	.311	.279	.424	.271	.363	.261
Volume Uncertainty	H_{TCE6}(-)						
Difficulty to predict demand volume	(-)	.303 ***	.083	.294 ***	.082	.293 ***	.082
Technological Uncertainty	H_{TCE7}(-)						
Speed x unpredictability of tech. devel. (TRsqrt)	(-)	.161	.144	.198	.141	.179	.137
Contribution Assessment Ability	H_{TCE9}(+)						
Ease of supplier performance evaluation	(+)	-.187 †	.107	-	-	-	-
Transaction Frequency	H_{TCE10}(-)						
Frequency of utilizing the transaction	(-)	-.162 *	.069	-.162 *	.069	-.144 *	.067
Unilateral Power Restructuring Operations	H_{RDT2}(+)						
Resource internal. potential (difficulty) (TRsqrt)	(-)	.214	.237	.264	.235	.212	.229
Resource Value I	H_{RBV1}(-)						
Contribution to higher gains	(-)	.105 *	.046	.105 *	.046	.080 *	.040
Resource Scarcity	H_{RBV4}(-)						
Natural resource scarcity	(-)	.181 *	.088	.181 *	.088	.157 †	.083
Resource Inimitability	H_{RBV5}(-)						
Intrafirm causal ambiguity	(-)	.093 †	.053	.100 †	.053	.101 *	.051
Interfirm causal ambiguity	(-)	-.013	.093	-.006	.093	-	-
Resource social complexity (TRsqrt)	(-)	.356 *	.157	.337 *	.156	.357 *	.154
Nagelkerke's R^2		.241		.232		.225	
Nagelkerke's Δ R^2		-		-		-	
Chi-Square Δ (Block)		71.716 ***		68.630 ***		66.394 ***	

360 case original dataset. n=360. † p<.10; * p<.05; ** p<.01; *** p<.001

The results of the multi-theoretic logistic regression model runs indicate that most of the variables found significant in the first place remain significant in the combined models as well. Disturbances associated with the inclusion of the contribution assessment ability variable are still detected in Model 1 particularly in reference to the agents' proprietary information variable.

Furthermore, when browsing through the results of Model 3 where previously non-significant component variables are excluded from the equation, it is worthy to note that a significant result emerges with regard to the principals' physical asset specificity variable. In particular, the finding (significant at the .05 level) holds that the higher a principal's physical asset specificity with regard to a particular activity is, the less likely that activity is to be outsourced.

A final point of interest arising when comparatively viewing the three multi-theoretic logistic regression models regards the classification ability of Model 3. In particular, while the model is the most frugal in terms of the number of variables included, it nonetheless offers comparatively strong classification improvements over the baseline reference mark of 54.2% with an additional 13.9% of the cases classified correctly.

Table 9-50. Multi-theoretic logistic regression results: Odds ratios (Imputed dataset)

		Model 1			Model 2			Model 3		
Variable	Hypoth.	Odds	Low	High	Odds	Low	High	Odds	Low	High
Intercept		.075			.056			.015		
Principal's Asset Specificity	H_{TCE2} (-)									
Principal's human asset specificity (TRsqrt)	(-)	.834	.455	1.529	.858	.471	1.563	-		
Principal's physical asset specificity (TRsqrt)	(-)	.655	.342	1.255	.623	.326	1.188	.534	.292	.977
Principal's dedicated asset specificity (TRsqrt)	(-)	.600	.319	1.129	.682	.373	1.247	-		
Principal's procedural asset specificity (TRsqrt)	(-)	1.853	.917	3.744	1.962	.971	3.964	1.635	.908	2.944
Principal's temporal specificity (TRsqrtRflct)	(+)	1.154	.729	1.826	1.215	.771	1.914	1.171	.761	1.801
Agent's Proprietary Assest Exposure	H_{TCE5} (+)									
Agent's brand name capital exposure	(+)	.943	.781	1.140	.936	.775	1.129	-		
Agent's proprietary info exposed (TRsqrt)	(+)	1.364	.790	2.356	1.529	.898	2.602	1.438	.863	2.397
Volume Uncertainty	H_{TCE6} (-)									
Difficulty to predict demand volume	(-)	1.353	1.150	1.593	1.342	1.142	1.577	1.341	1.141	1.575
Technological Uncertainty	H_{TCE7} (-)									
Speed x unpredictability of tech. devel. (TRsqrt)	(-)	1.174	.886	1.556	1.219	.924	1.608	1.196	.914	1.566
Contribution Assessment Ability	H_{TCE9} (+)									
Ease of supplier performance evaluation	(+)	.830	.673	1.023				-		
Transaction Frequency	H_{TCE10} (-)									
Frequency of utilizing the transaction	(-)	.851	.742	.975	.850	.743	.973	.866	.759	.987
Unilateral Power Restructuring Operations	H_{RDT2} (+)									
Resource internal. potential (difficulty) (TRsqrt)	(-)	1.239	.779	1.969	1.302	.821	2.065	1.236	.790	1.936
Resource Value I	H_{RBV1} (-)									
Contribution to higher gains	(-)	1.111	1.015	1.215	1.111	1.016	1.214	1.084	1.003	1.171
Resource Scarcity	H_{RBV4} (-)									
Natural resource scarcity	(-)	1.199	1.008	1.425	1.198	1.009	1.422	1.170	.995	1.376
Resource Inimitability	H_{RBV5} (-)									
Intrafirm causal ambiguity	(-)	1.097	.989	1.217	1.105	.997	1.226	1.107	1.001	1.224
Interfirm causal ambiguity	(-)	.987	.823	1.184	.994	.829	1.191	-		
Resource social complexity (TRsqrt)	(-)	1.428	1.050	1.943	1.401	1.031	1.904	1.429	1.056	1.933
Overall percentage classified correctly (%)		68.3			67.2			68.1		
Correct classification Δ (%)		14.1			13.0			13.9		

360 case imputed dataset. n=360. † p<.10; * p<.05; ** p<.01; *** p<.001

The best fitting model in the individual examination of each perspective was Model 10b, formed in the investigation of efficiency–based considerations. The model yielded a chi-square statistic of 48.680 while offering a contribution of approximately 16.9% in Nagelkerke's analogue to R^2. Additionally, the particular model classified 65.3% of activity cases correctly (with 55.8% of the cases classified correctly in the non-outsourced category and 73.3% rightly classified in the outsourced category). In comparison, the most economical of the multi-theoretic logistic regression models (i.e. Model 3) yielded a chi-square statistic of 66.394 while offering a contribution of 22.5% in Nagelkerke's R^2 statistic. At the same time, the particular model classified 68.1% of the cases correctly (with 61.2% classified correctly in the non-outsourced category and 73.8% rightly classified in the outsourced category).

In view of these findings, it is put forth that a multi-theoretic or otherwise combined-perspective approach to the explanation of maintenance activity sourcing states, in particular, as well as corporate resource sourcing phenomena, in general, is perhaps a more productive avenue for further research in the academic discourses surrounding the servitization of capital equipment as well as general insourcing/outsourcing or otherwise firm-boundary related inquiries.

9.6 Impact of considerations on activity outsourcing levels: linear regression

Having explored the different considerations' influence on the decision to outsource an activity or not, emphasis is now put on the exploration of the same considerations' influence over the level of activity outsourcing once the decision to outsource is a given. As such, focus is put on the application of multiple linear regression analysis in the study's 195 case datasets (original and imputed) that include only the cases of activities outsourced to any degree. The aim of the analysis is to investigate which considerations from each of the study's strategic perspectives (i.e. efficiency, dependency, competence and identity) significantly influence the outsourcing level (or otherwise the degree of outsourcing) of a maintenance activity. As such, in this regression analysis technique, the dependent outcome is defined as a continuous variable depicting the level of activity outsourcing. The variable is identified in the datasets through the ActivityOutsourcingOnly_TRlog10 label.

A hierarchical (or otherwise stepwise or sequential) approach to the application of multiple linear regression (similar with the preceding analyses) is adopted. In accordance with this technique, groups of variables (variable blocks) are entered into the regression equation hierarchically according to theoretical concerns. As such, each independent variable (or block of variables) entered in the equation is assessed in terms of improvements offered in the prediction of the dependent variable, once the influence of previously entered variables is controlled for. The model building process holds that within each strategic perspective, variables (or blocks) enter the regression equation and are subsequently checked with regard to the significance of their contributions to the explanation of variance in the dependent variable. If the contribution is not significant the variables are excluded from the regression model and the next set of variables is entered and assessed. If the contribution is significant, then the variables are retained in the model and the next set is entered and assessed. The process is repeated until there are no more variables left to enter the regression equation, at which point a parsimonious model is retrieved.

In applying multiple linear regression analysis, a series of specific assumptions are taken into consideration. These include the absence of outliers, multicollinearity and singularity between independent variables and the presence of normality, linearity and homoscedasticity between predicted dependent variable scores and the errors of prediction (Tabachnick and Fidell, 2007 pp. 124-125). Univariate normality and outlier concerns have already been addressed in the study's data screening process. Checks for multicollinearity are performed through a visual inspection of each regression's associated variable correlation matrix and assorted collinearity statistics provided by SPSS. Singularity issues are addressed by ensuring that when composite formed variables are utilized in the analyses no regard is given to their forming components. Finally, the assumptions of multivariate normality, linearity and homoscedasticity are examined through the visual inspection of each regression's residuals scatterplots (see Appendices B.4 and B.5).

The following sub-sections report the application of the regression model-building process for each of the strategic considerations after the assessment of the study's control variables. Any control variables found significant are subsequently used as the first variables to enter the regression equation of each strategic perspective under study. In reporting the results of the study's hierarchical regression analyses, a variable correlation matrix is first offered to be then followed by two tables recounting each analysis's particulars (unstandardized and standardized coefficients).

9.6.1 Control variable hierarchical multiple regression

The control variables of the study include the concepts of firm size, firm age and firm average ship age. As mentioned previously, while the last two concepts are each operationalized through unique measures, the concept of firm size is associated with four relevant metrics. Those include: the number of firm employees on shore, the number of firm employees at sea, the number of firm ships as well as the total DWT (deadweight tonnage) of firm ships. Given that all of the above measures of firm size try to capture the same underlying contstruct, high correaltions between them are expected. Table 9-51 presents the correlation matrix of the study's control variables in the 195 case original dataset (a table for the imputed dataset is uneccessary as no imputations were performed).

Table 9-51. Control variable correlation matrix (195 case original dataset)

Variable	1	2	3	4	5	6	7
1 Activity Outsourcing (TRlog10)	1.000						
2 Firm size - Employees on shore (TRlog10)	-.183 *	1.000					
3 Firm size - Employees at sea (TRlog10)	-.148 *	.837 ***	1.000				
4 Firm size - Number of ships (TRlog10)	-.155 *	.891 ***	.918 ***	1.000			
5 Firm Size - Total DWT (TRlog10)	-.190 **	.842 ***	.812 ***	.857 ***	1.000		
6 Firm Age (TRsqrt)	-.137 *	.356 ***	0.294 ***	.363 ***	.299 ***	1.000	
7 Average Ship Age (TRsqrt)	.088	-.159 *	-.166 *	-.194 **	-.280 ***	-.142 *	1.000

195 case original dataset. n=195. * p<.05; ** p<.01; *** p<.001

Expectedly, the correlation matrix reveals high and significant correlations amonge the variables of firm size. The degree of correlation is such, that concerns for the presence of multicollinearity are raised once more. Therefore, it is again decided that only one variable will be allowed to represent the concept in the regression model-building process. The selection of the measure was performed through predictive validity checks. Accordingly, a series of standard regression equations were run with each firm size variable attempting to predict the dependent outcome. The variable that presented the higher amount of variance explained (R^2), along with the most significant coefficients, was finally selected. The elected measure is that of a firm's total DWT. Given the above, Tables 9-52 ad 9-53 report on the linear regression model-building process for the study's control variables.

Table 9-52. Control variable multiple regression results: Unstandardized coefficients

		Model 1		Model 2		Model 3	
Variable	Hypoth.	**Coef.**	**St.Er.**	Coef.	St.Er.	Coef.	St.Er.
Intercept		2.008 ***	.288	1.988 ***	.288	1.901 ***	.355
Firm Size							
Firm size - Total DWT (TRlog10)	(±)	-.130 **	.048	-.112 *	.051	-.123 *	.050
Firm Age							
Firm Age (TRsqrt)	(±)			-.014	.012		
Firm Average Ship Age							
Average Ship Age (TRsqrt)	(±)					.022	.043
R^2		.036		.043		.038	
ΔR^2		.036		.007		.001	
Δ F		7.266 **		1.398		.263	

195 case original dataset. n=195. † p<.10; * p<.05; ** p<.01; *** p<.001

The primary results table (9-52) reports each regression model's intercept (constant), each variable's unstandardized regression coefficients along with their significance and associated standard errors, the amount of dependent variable variance explained by the model (R^2) along with its significance, the change in explained variance due to a variable's (or block's) entrance in the regression equation (ΔR^2) and finally the change in the model fit F statistic (ΔF) along with its associated significance levels.

Table 9-53. Control variable multiple regression results: Standardized coefficients

		Model 1	Model 2	Model 3
Variable	Hypoth.	**Coef.**	Coef.	Coef.
Firm Size				
Firm size - Total DWT (TRlog10)	~	-.190 **	-.164 *	-.180 *
Firm Age				
Firm Age (TRsqrt)	~		-.087	
Firm Average Ship Age				
Average Ship Age (TRsqrt)	~			.038
R^2		.036	.043	.038
ΔR^2		.036	.007	.001
ΔF		7.266 **	1.398	.263

195 case original dataset. n=195. † p<.10; * p<.05; ** p<.01; *** p<.001

The secondary results table (Table 9-53), reports each regression model's standardized variable regression coefficients (along with their significance) and reiterates the explained variance (R^2), explained variance change (ΔR^2) and model fit change (ΔF) statistics for reference purposes.

The assessment of the three control variable multiple regression models indicates that only the variable of firm size (Total DWT) contributes significantly in the explanation of unique variance in activity outsourcing levels so that the higher firm size is, the lower the level of outsourcing. The rest of the control variables did not yield significant changes in model fit when entered in the regression equation. As such, Model 1 is elected as the best fitting control variable regression model with a total of 3.6% of the dependent outcome variance explained (a percentage from hereon regarded as the baseline reference). Given the aforementioned results, the control variable of firm size, as represented by a firm's total ship DWT, is utilized in the rest of the regression model-building processes as the first variable to enter the regression equation. As such, the various theoretically derived considerations are asked to provide explanations of variance above and beyond that offered by firm size.

9.6.2 Efficiency-based variable hierarchical multiple regression

With regard to the exploration of efficiency-based considerations, the entrance sequence of variables in the equation is identical to the one used for logistic regression. As such, the concern of behavioural uncertainty is entered first, followed by the principals' asset specificity and proprietary asset exposure variables. Subsequently, the agents' asset specificity and proprietary asset exposure variables follow suite. Afterwards, the variables of volume and technological uncertainty are entered, followed by the concerns of value assessment and contribution assessment ability. The sequence is concluded by the consideration of transaction frequency.

Tables 9-54 and 9-55 present the variable correlation matrices for the original and imputed 195 case datasets. Changes in correlation significance levels observed in the imputed dataset, are highlighted in Table 9-55. Tables 9-56 through 9-59, report the results of the multiple regression model-building process for the study's efficiency-based variables in the 195 case original (Tables 9-56 and 9-58) and imputed (Tables 9-57 and 9-59) dataset. Highlighted values here denote statistically significant results.

Table 9-54. Efficiency-based variable correlation matrix (195 case original dataset)

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1 Activity Outsourcing (TRlog10)	1.000																				
2 Principal's human asset specificity (TRsqrt)	-.054	1.000																			
3 Principal's physical asset specificity (TRsqrt)	.099	.589 ***	1.000																		
4 Principal's dedicated asset specificity (TRsqrt)	.266 ***	.529 ***	.573 ***	1.000																	
5 Principal's procedural asset specificity (TRsqrt)	.055	.707 ***	.791 ***	.582 ***	1.000																
6 Principal's temporal specificity (TRsqrtRflct)	.102	.068	.036	-.029	.036	1.000															
7 Principal's brand capital exposure (TRsqrtRflct)	.105	.123	.176 *	.032	.120	.493 ***	1.000														
8 Principal's proprietary info exposed (TRsqrt)	.062	.254 **	.201 *	.414 ***	.198 *	-.113	.082	1.000													
9 Agent's human asset specificity	-.034	-.064	-.022	-.061	.016	.113	.260 **	.239 **	1.000												
10 Agent's physical asset specificity	.118	-.140	.068	-.078	.006	.069	.323 ***	.120	.682 ***	1.000											
11 Agent's dedicated asset specificity	.092	-.171 *	-.245 **	-.131	-.184 *	.053	.151	.116	.667 ***	.726 ***	1.000										
12 Agent's procedural asset specificity	.104	.009	.067	-.080	.177 *	.102	.266 **	.205 *	.690 ***	.764 ***	.736 ***	1.000									
13 Agent's temporal asset specificity	.067	-.253 **	-.442 ***	-.084	-.383 ***	.112	-.025	.149	.249 **	.079	.408 ***	.208 *	1.000								
14 Agent's brand name capital exposure	.073	.114	.035	.113	.009	-.080	-.107	.169	.125	.367 ***	.369 ***	.418 ***	.311 ***	1.000							
15 Agent's proprietary info exposed (TRsqrt)	-.075	.149	.105	.133	.079	-.222 **	-.020	.398 ***	.034	.081	-.039	.074	.034	.118	1.000						
16 Behavioural uncertainty (unreliability)	-.216 **	.041	.023	-.122	.074	-.166 *	.099	-.035	-.045	-.124	-.193 *	-.032	-.322 ***	-.152	.320 ***	1.000					
17 Volume uncertainty (demand unpredictability)	.072	.069	.054	.095	.097	.365 ***	.195 **	-.037	.079	-.080	.058	.084	.145	.092	-.003	-.083	1.000				
18 Technological Uncertainty (TRsqrt) (speed x unpr.)	.038	.177 *	.073	.103	.064	.137	-.011	-.051	.043	.009	.041	.142	-.019	.277 **	-.080	-.143	.151	1.000			
19 Value assessment ability (pricing ease)	-.152 *	-.063	.078	-.202 **	-.030	-.252 **	-.024	.042	-.071	.018	-.200 *	-.081	-.256 **	-.269 **	.107	.155 *	-.596 ***	-.182 *	1.000		
20 Contribution assessment ability (evaluation ease)	-.035	-.490 ***	-.292 ***	-.495 ***	-.402 ***	-.086	.134	-.190 *	.227 **	.196 *	.159 *	.056	.064	-.097	-.160 *	.182 *	-.066	-.249 **	.144	1.000	
21 Transaction Frequency	-.070	.029	.070	.041	.159 *	-.013	.131	.012	-.089	-.197 *	-.086	-.100	-.087	-.178 *	-.019	-.074	.003	.005	.055	.051	1.000

195 case original dataset. n=195. * p<.05; ** p<.01; *** p<.001

Table 9-55. Efficiency-based variable correlation matrix (195 case imputed dataset)

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1 Activity Outsourcing (TRlog10)	1.000																				
2 Principal's human asset specificity (TRsqrt)	-.026	1.000																			
3 Principal's physical asset specificity (TRsqrt)	.100	.577 ***	1.000																		
4 Principal's dedicated asset specificity (TRsqrt)	.238 **	.511 ***	.567 ***	1.000																	
5 Principal's procedural asset specificity (TRsqrt)	.021	.663 ***	.767 ***	.580 ***	1.000																
6 Principal's temporal specificity (TRsqrtRflct)	.108	.058	.059	-.020	.043	1.000															
7 Principal's brand capital exposure (TRsqrtRflct)	.104	.128	.189 **	.035	.106	.491 ***	1.000														
8 Principal's proprietary info exposed (TRsqrt)	.044	.244 **	.175 *	.371 ***	.183 *	-.100	.097	1.000													
9 Agent's human asset specificity	.017	-.014	-.014	-.065	-.013	.106	.226 **	.222 **	1.000												
10 Agent's physical asset specificity	.118	.026	.086	.020	.018	.092	.319 ***	.199 **	.615 ***	1.000											
11 Agent's dedicated asset specificity	.067	-.017	-.253 ***	-.027	-.144 *	.033	.086	.154 *	.569 ***	.643 ***	1.000										
12 Agent's procedural asset specificity	.101	.057	.049	-.059	.076	.110	.238 **	.166 *	.621 ***	.662 ***	.646 ***	1.000									
13 Agent's temporal asset specificity	.026	-.151 *	-.388 ***	-.071	-.347 ***	.075	-.053	.149 *	.247 ***	.078	.384 ***	.189 **	1.000								
14 Agent's brand name capital exposure	.105	.100	.036	.092	.023	-.056	-.043	.152 *	.141 *	.290 ***	.342 ***	.384 ***	.231 **	1.000							
15 Agent's proprietary info exposed (TRsqrt)	-.094	.120	.118	.150 *	.136	-.229 **	.041	.399 ***	.056	.096	.023	.116	-.034	.005	1.000						
16 Behavioural uncertainty (unreliability)	-.211 **	.051	.046	-.080	.102	-.159 *	.114	.016	-.056	-.121	-.169 *	-.044	-.259 ***	-.136	.283 ***	1.000					
17 Volume uncertainty (demand unpredictability)	.087	.103	.086	.079	.033	.325 ***	.179 *	-.076	.061	-.025	.016	.131	.079	.090	-.059	-.100	1.000				
18 Technological Uncertainty (TRsqrt) (speed x unpr.)	.045	.178 *	.049	.089	.079	.106	-.003	.003	.092	-.007	.039	.085	-.018	.136	-.129	-.088	.138	1.000			
19 Value assessment ability (pricing ease)	-.142 *	-.063	.071	-.169 *	-.022	-.250 ***	-.032	.023	-.040	.005	-.144 *	-.093	-.210 **	-.167 *	.112	.136	-.502 ***	-.120	1.000		
20 Contribution assessment ability (evaluation ease)	-.037	-.465 ***	-.300 ***	-.456 ***	-.372 ***	-.077	.118	-.125	.174 *	.074	.056	.039	.072	-.048	-.178 *	.113	-.029	-.155 *	.185 **	1.000	
21 Transaction Frequency	-.104	.010	.079	.020	.144 *	-.002	.115	.002	-.154 *	-.182 *	-.156 *	-.109	-.075	-.179 *	.040	-.015	-.057	.021	.051	.028	1.000

195 case imputed dataset. n=195. * p<.05; ** p<.01; *** p<.001

Table 9-56. Efficiency-based variable multiple regression results: Unstandardized coefficients (Original dataset)

		Control		Model 1		**Model 2**		Model 3		Model 4		Model 5		Model 6		Model 7		Model 8		Model 9		Model 10	
Variable	Hypoth.	Coef.	St.Er.	Coef.	St.Er.	**Coef.**	**St.Er.**	Coef.	St.Er.	Coef.	St.Er.	Coef.	St.Er.	Coef.	St.Er.	Coef.	St.Er.	Coef.	St.Er.	Coef.	St.Er.	Coef.	St.Er.
Intercept		2.008 ***	.288	2.110 ***	.297	1.551 ***	.353	1.568 ***	.377	1.262 **	.435	1.496 ***	.417	1.552 ***	.360	1.544 ***	.406	1.605 ***	.363	1.351 **	.412	1.606 ***	.356
Control Variables																							
Firm size - Total DWT (TRlog10)		-.130 **	.048	-.115 *	.050	-.059	.052	-.059	.054	-.018	.063	-.058	.059	-.059	.053	-.059	.056	-.056	.052	-.054	.053	-.053	.052
Behavioural Uncertainty	H_{TCE1} (-)																						
Unreliability of suppliers	(-)			-.078 **	.029	-.055 †	.030	-.064 *	.031	-.052	.034	-.050	.036	-.055 †	.030	-.055 †	.032	-.054 †	.030	-.060 *	.030	-.059 †	.030
Principal's Asset Specificity	H_{TCE2} (-)																						
Principal's human asset specificity (TRsqrt)	(-)					-.204 *	.080	-.201 *	.083	-.194 *	.087	-.211 *	.092	-.204 *	.081	-.205 *	.088	-.205 *	.080	-.183 *	.083	-.215 **	.081
Principal's physical asset specificity (TRsqrt)	(-)					.042	.088	.021	.092	.030	.104	.042	.100	.042	.090	.042	.095	.056	.091	.028	.090	.032	.089
Principal's dedicated asset specificity (TRsqrt)	(-)					.276 **	.081	.296 **	.087	.341 **	.099	.275 **	.092	.276 **	.082	.276 **	.087	.262 **	.084	.301 **	.085	.274 **	.081
Principal's procedural asset specificity (TRsqrt)	(-)					.008	.103	.011	.106	-.065	.125	.012	.117	.008	.105	.008	.111	.003	.103	.017	.103	.035	.105
Principal's temporal specificity (TRsqrtRflct)	(+)					.067	.053	.020	.064	.079	.056	.070	.061	.068	.058	.067	.057	.058	.055	.071	.053	.066	.053
Principal's Proprietary Asset Exposure	H_{TCE3} (-)																						
Principal's brand capital exposure (TRsqrtRflct)	(+)							.083	.063														
Principal's proprietary info exposed (TRsqrt)	(-)							-.047	.074														
Agent's Asset Specificity	H_{TCE4} (+)																						
Agent's human asset specificity	(+)									-.074 *	.032												
Agent's physical asset specificity	(+)									.014	.042												
Agent's dedicated asset specificity	(+)									.006	.046												
Agent's procedural asset specificity	(+)									.074	.050												
Agent's temporal asset specificity	(+)									-.008	.026												
Agent's Proprietary Assest Exposure	H_{TCE5} (+)																						
Agent's brand name capital exposure	(+)											.018	.027										
Agent's proprietary info exposed (TRsqrt)	(+)											-.019	.101										
Volume Uncertainty	H_{TCE6} (-)																						
Difficulty to predict demand volume	(-)													.000	.020								
Technological Uncertainty	H_{TCE7} (-)																						
Speed x unpredictability of tech. devel. (TRsqrt)	(-)															.002	.038						
Value Assessment Ability	H_{TCE8} (+)																						
Ease of pricing tasks in the activity	(+)																	-.014	.022				
Contribution Assessment Ability	H_{TCE9} (+)																						
Ease of supplier performance evaluation	(+)																			.027	.029		
Transaction Frequency	H_{TCE10} (-)																						
Frequency of utilizing the transaction	(-)																					-.022	.018
R^2		.036		.074		.168		.178		.212		.170		.168		.168		.170		.172		.175	
ΔR^2		.036		.038		.093		.011		.045		.003		.000		.000		.002		.005		.008	
ΔF		7.266 **		7.278 **		3.537 **		.975		1.544		.215		.000		.002		.428		.884		1.443	

195 case original dataset. n=195. † p<.10; * p<.05; ** p<.01; *** p<.001

Table 9-57. Efficiency-based variable multiple regression results: Unstandardized coefficients (Imputed dataset)

		Control		Model 1		**Model 2**		Model 3		Model 4		Model 5		Model 6		Model 7		Model 8		Model 9		Model 10	
Variable	Hypoth.	Coef.	St.Er.	Coef.	St.Er.	**Coef.**	**St.Er.**	Coef.	St.Er.	Coef.	St.Er.	Coef.	St.Er.	Coef.	St.Er.	Coef.	St.Er.	Coef.	St.Er.	Coef.	St.Er.	Coef.	St.Er.
Intercept		2.008 ***	.288	2.117 ***	.286	1.699 ***	.320	1.705 ***	.333	1.555 **	.365	1.626 ***	.342	1.687 ***	.322	1.663 ***	.338	1.770 ***	.329	1.581 ***	.370	1.749 ***	.321
Control Variables																							
Firm size - Total DWT (TRlog10)		-.130 **	.048	-.117 *	.048	-.084 †	.048	-.083 †	.048	-.063	.051	-.077	.048	-.084 †	.048	-.083 †	.048	-.081 †	.048	-.082 †	.048	-.078	.048
Behavioural Uncertainty	H_{TCE1} (-)																						
Unreliability of suppliers	(-)			-.077 **	.028	-.058 *	.028	-.065 *	.028	-.059 *	.029	-.049 †	.029	-.057 *	.028	-.057 *	.028	-.056 *	.028	-.060 *	.028	-.060 *	.028
Principal's Asset Specificity	H_{TCE2} (-)																						
Principal's human asset specificity (TRsqrt)	(-)					-.118 †	.070	-.117 †	.070	-.117	.071	-.124 †	.070	-.120 †	.070	-.121 †	.071	-.120 †	.070	-.105	.072	-.127 †	.070
Principal's physical asset specificity (TRsqrt)	(-)					.096	.081	.075	.082	.065	.093	.096	.081	.094	.081	.098	.081	.112	.082	.092	.081	.093	.080
Principal's dedicated asset specificity (TRsqrt)	(-)					.246 **	.075	.263 **	.079	.277 **	.082	.250 **	.076	.244 **	.076	.245 **	.076	.230 **	.077	.259 **	.079	.242 **	.075
Principal's procedural asset specificity (TRsqrt)	(-)					-.099	.090	-.090	.091	-.115	.094	-.095	.091	-.096	.091	-.099	.091	-.103	.090	-.096	.091	-.077	.092
Principal's temporal specificity (TRsqrtRflct)	(+)					.061	.049	.018	.058	.060	.050	.059	.050	.054	.052	.059	.049	.049	.051	.063	.049	.060	.049
Principal's Proprietary Asset Exposure	H_{TCE3} (-)																						
Principal's brand capital exposure (TRsqrtRflct)	(+)							.076	.058														
Principal's proprietary info exposed (TRsqrt)	(-)							-.042	.065														
Agent's Asset Specificity	H_{TCE4} (+)																						
Agent's human asset specificity	(+)									-.026	.026												
Agent's physical asset specificity	(+)									.016	.030												
Agent's dedicated asset specificity	(+)									-.009	.034												
Agent's procedural asset specificity	(+)									.040	.031												
Agent's temporal asset specificity	(+)									-.010	.021												
Agent's Proprietary Assest Exposure	H_{TCE5} (+)																						
Agent's brand name capital exposure	(+)											.023	.022										
Agent's proprietary info exposed (TRsqrt)	(+)											-.046	.069										
Volume Uncertainty	H_{TCE6} (-)																						
Difficulty to predict demand volume	(-)													.007	.018								
Technological Uncertainty	H_{TCE7} (-)																						
Speed x unpredictability of tech. devel. (TRsqrt)	(-)															.011	.033						
Value Assessment Ability	H_{TCE8} (+)																						
Ease of pricing tasks in the activity	(+)																	-.018	.020				
Contribution Assessment Ability	H_{TCE9} (+)																						
Ease of supplier performance evaluation	(+)																			.016	.025		
Transaction Frequency	H_{TCE10} (-)																						
Frequency of utilizing the transaction	(-)																					-.023	.017
R^2		.036		.073		.148		.157		.164		.155		.149		.148		.152		.150		.156	
ΔR^2		.036		.037		.074		.009		.016		.007		.001		.000		.004		.002		.008	
ΔF		7.266 **		7.710 **		3.261 **		.977		.688		.753		.157		.106		.834		.401		1.850	

195 case imputed dataset. n=195. † $p<.10$; * $p<.05$; ** $p<.01$; *** $p<.001$

Table 9-58. Efficiency-based variable multiple regression results: Standardized coefficients (Original dataset)

		Control	Model 1	**Model 2**	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
Variable	Hypoth.	Coef.	Coef.	**Coef.**	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
Control Variables												
Firm size - Total DWT (TRlog10)		-.190 **	-.168 *	-.087	-.087	-.026	-.085	-.087	-.086	-.083	-.080	-.078
Behavioural Uncertainty	H_{TCE1}(-)											
Unreliability of suppliers	(-)		-.196 **	-.139 †	-.161 *	-.131	-.125	-.139 †	-.139 †	-.136 †	-.153 *	-.149 †
Principal's Asset Specificity	H_{TCE2}(-)											
Principal's human asset specificity (TRsqrt)	(-)			-.270 *	-.266 *	-.257 *	-.279 *	-.270 *	-.271 *	-.271 *	-.243 *	-.285 **
Principal's physical asset specificity (TRsqrt)	(-)			.058	.030	.041	.058	.058	.058	.078	.038	.045
Principal's dedicated asset specificity (TRsqrt)	(-)			.340 **	.364 **	.420 **	.339 **	.340 **	.340 **	.323 **	.371 **	.337 **
Principal's procedural asset specificity (TRsqrt)	(-)			.010	.015	-.087	.017	.010	.011	.004	.023	.047
Principal's temporal specificity (TRsqrtRflct)	(+)			.095	.028	.112	.099	.095	.095	.082	.100	.093
Principal's Proprietary Asset Exposure	H_{TCE3}(-)											
Principal's brand capital exposure (TRsqrtRflct)	(+)				.120							
Principal's proprietary info exposed (TRsqrt)	(-)				-.054							
Agent's Asset Specificity	H_{TCE4}(+)											
Agent's human asset specificity	(+)					-.272 *						
Agent's physical asset specificity	(+)					.053						
Agent's dedicated asset specificity	(+)					.021						
Agent's procedural asset specificity	(+)					.267						
Agent's temporal asset specificity	(+)					-.034						
Agent's Proprietary Assest Exposure	H_{TCE5}(+)											
Agent's brand name capital exposure	(+)						.055					
Agent's proprietary info exposed (TRsqrt)	(+)						-.017					
Volume Uncertainty	H_{TCE6}(-)											
Difficulty to predict demand volume	(-)							-.001				
Technological Uncertainty	H_{TCE7}(-)											
Speed x unpredictability of tech. devel. (TRsqrt)	(-)								.004			
Value Assessment Ability	H_{TCE8}(+)											
Ease of pricing tasks in the activity	(+)									-.053		
Contribution Assessment Ability	H_{TCE9}(+)											
Ease of supplier performance evaluation	(+)										.086	
Transaction Frequency	H_{TCE10}(-)											
Frequency of utilizing the transaction	(-)											-.090
R^2		.036	.074	.168	.178	.212	.170	.168	.168	.170	.172	.175
ΔR^2		.036	.038	.093	.011	.045	.003	.000	.000	.002	.005	.008
ΔF		7.266 **	7.278 **	3.537 **	.975	1.544	.215	.000	.002	.428	.884	1.443

195 case original dataset. n=195. † p<.10; * p<.05; ** p<.01; *** p<.001

Table 9-59. Efficiency-based variable multiple regression results: Standardized coefficients (Imputed dataset)

		Control	Model 1	**Model 2**	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
Variable	Hypoth.	Coef.	Coef.	**Coef.**	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
Control Variables												
Firm size - Total DWT (TRlog10)		-.190 **	-.171 *	-.123 †	-.122 †	-.092	-.113	-.123 †	-.122 †	-.119 †	-.120 †	-.114
Behavioural Uncertainty	H_{TCE1}(-)											
Unreliability of suppliers	(-)		-.194 **	-.146 *	-.166 *	-.149 *	-.124 †	-.145 *	-.145 *	-.142 *	-.152 *	-.151 *
Principal's Asset Specificity	H_{TCE2}(-)											
Principal's human asset specificity (TRsqrt)	(-)			-.157 †	-.157 †	-.157	-.166 †	-.160 †	-.162 †	-.161 †	-.141	-.171 †
Principal's physical asset specificity (TRsqrt)	(-)			.130	.102	.088	.130	.128	.132	.152	.124	.126
Principal's dedicated asset specificity (TRsqrt)	(-)			.294 **	.314 **	.331 **	.299 **	.292 **	.293 **	.275 **	.310 **	.289 **
Principal's procedural asset specificity (TRsqrt)	(-)			-.131	-.119	-.151	-.125	-.126	-.130	-.135	-.127	-.102
Principal's temporal specificity (TRsqrtRflct)	(+)			.085	.026	.085	.083	.076	.084	.069	.088	.085
Principal's Proprietary Asset Exposure	H_{TCE3}(-)											
Principal's brand capital exposure (TRsqrtRflct)	(+)				.109							
Principal's proprietary info exposed (TRsqrt)	(-)				-.048							
Agent's Asset Specificity	H_{TCE4}(+)											
Agent's human asset specificity	(+)					-.096						
Agent's physical asset specificity	(+)					.060						
Agent's dedicated asset specificity	(+)					-.030						
Agent's procedural asset specificity	(+)					.144						
Agent's temporal asset specificity	(+)					-.039						
Agent's Proprietary Assest Exposure	H_{TCE5}(+)											
Agent's brand name capital exposure	(+)						.072					
Agent's proprietary info exposed (TRsqrt)	(+)						-.049					
Volume Uncertainty	H_{TCE6}(-)											
Difficulty to predict demand volume	(-)							.029				
Technological Uncertainty	H_{TCE7}(-)											
Speed x unpredictability of tech. devel. (TRsqrt)	(-)								.023			
Value Assessment Ability	H_{TCE8}(+)											
Ease of pricing tasks in the activity	(+)									-.067		
Contribution Assessment Ability	H_{TCE9}(+)											
Ease of supplier performance evaluation	(+)										.051	
Transaction Frequency	H_{TCE10}(-)											
Frequency of utilizing the transaction	(-)											-.094
R^2		.036	.073	.148	.157	.164	.155	.149	.148	.152	.150	.156
ΔR^2		.036	.037	.074	.009	.016	.007	.001	.000	.004	.002	.008
ΔF		7.266 **	7.710 **	3.261 **	.977	.688	.753	.157	.106	.834	.401	1.850

195 case imputed dataset. n=195. † p<.10; * p<.05; ** p<.01; *** p<.001

In the case of multiple linear regression, both results derived from the original 195 case dataset (with missing values) as well as the imputed 195 case dataset are offered. While compound missing value rates are still a concern, the issue is aleviated partly by the application of pairwise (instead of listwise) exclusion of cases as well as the lower levels of missing data observed in the original 195 case dataset. As such, both datasets' models are taken into consideration in interpreting the results.

The results tables with regard to efficiency-based variables reveal a limited number of significant, yet still interesting, findings. First of all, Model 1, indicates that the higher behavioural uncertainty (as perceived by principals on behalf of agents) is, the lower the level of activity outsourcing. The finding is significant at the .01 level in both datasets and offers an explanation of a further 3.8% in the variance of the dependent outcome. Model 2, then indicates that the higher the principals' human asset specificity is, again the lower the level of activity outsourcing. At the same time, however the model further indicates that the higher principals' dedicated asset specificity is, the higher the level of activity outsourcing. The first finding is significant at the .10 and .05 levels in the original and imputed datasets respectively, while the second is consistently significant at the .01 level in both datasets. In unison, the principal's asset specificity variables offer a further explanation of 9.3% of the dependent variable's variance with a total of 16.8% explained in the original dataset, while the figures for the imputed dataset drop to 7.4% and 14.8% respectively.

Models 3 to 10 examine the rest of the efficiency-based variables. The ΔF statistic, however, does not indicate any significant contributions to the explanation of outsourcing levels in either dataset. A somewhat notable exception is provided in Model 4 by the agents' human asset spcificity variable where it is indicated that the higher the level of said specificity, the lower the level of activity outsourcing. The finding, however, is significant at the .05 level only in the original dataset with 54 cases missing. As such, Model 2 is retreived as the parsimonious linear regression model for efficiency-based variables.

9.6.3 Dependency-based variable hierarchical multiple regression

Continuing the exploration of the study's main independent variables, focus is put on dependency-based considerations. With regard to their entrance sequence, the proxy of power imbalance identified as the principal's general dependence on agents is entered first (with all of the associated caveats related to the inclusion of only one aspect of power imbalance firmly recognized). Subsequently, concerns of unilateral and bilateral power restructuring operations are entered in the equation in the guise of the principals' resource internalization potential difficulty and cooptation potential ability variables. Finally, the sequence is concluded by the consideration of the agents' actual dependence on principals (operationalized through the principals' input to agents' circle of operations).

Tables 9-60 and 9-61 present the variable correlation matrices for the original and imputed 195 case datasets. Changes in correlation significance levels observed in the imputed dataset, are highlighted in Table 9-61. Tables 9-62 through 9-65, report the results of the multiple regression model-building process for the study's dependency-based variables in the 195 case original (Tables 9-62 and 9-64) and imputed (Tables 9-63 and 9-65) dataset. Highlighted values here denote statistically significant results.

Table 9-60. Dependency-based variable correlation matrix (195 case original dataset)

Variable	1	2	3	4	5
1 Activity Outsourcing (TRlog10)	1.000				
2 Principal's dependence on agents (TRlog10)	.265 ***	1.000			
3 Resource internal. potential (difficulty) (TRsqrt)	.044	-.075	1.000		
4 Cooptation potential	.224 **	.165 *	.217 **	1.000	
5 Principal's input to agent business (TRsqrt)	.214 *	.247 **	.053	.575 ***	1.000

195 case original dataset. n=195. * $p<.05$; ** $p<.01$; *** $p<.001$

Table 9-61. Dependency-based variable correlation matrix (195 case imputed dataset)

Variable	1	2	3	4	5
1 Activity Outsourcing (TRlog10)	1.000				
2 Principal's dependence on agents (TRlog10)	.256 ***	1.000			
3 Resource internal. potential (difficulty) (TRsqrt)	.061	.038	1.000		
4 Cooptation potential	.210 **	.141 *	.215 **	1.000	
5 Principal's input to agent business (TRsqrt)	.174 *	.135	.093	.360 ***	1.000

195 case imputed dataset. n=195. * $p<.05$; ** $p<.01$; *** $p<.001$

Table 9-62. Dependency-based variable multiple regression results: Unstandardized coefficients (Original dataset)

		Control		Model 1		Model 2		**Model 3**		Model 4	
Variable	Hypoth.	Coef.	St.Er.	Coef.	St.Er.	Coef.	St.Er.	**Coef.**	**St.Er.**	Coef.	St.Er.
Intercept		2.008 ***	.288	2.158 ***	.299	2.106 ***	.347	2.090 ***	.311	2.236 ***	.380
Control Variables											
Firm size - Total DWT (TRlog10)		-.130 **	.048	-.145 **	.050	-.141 **	.053	-.164 **	.052	-.193 **	.065
Power Imbalance (proxy)	H_{RDT1}(+)										
Principal's dependence on agents (TRlog10)	(-)			.205 ***	.053	.206 ***	.056	.181 **	.056	.162 *	.067
Unilateral Power Restructuring Operations	H_{RDT2}(+)										
Resource internal. potential (difficulty) (TRsqrt)	(-)					.021	.058				
Bilateral Power Restructuring Operations	H_{RDT3}(+)										
Cooptation potential	(+)							.057 **	.020	.033	.029
Agent Actual Dependence	H_{RDT4}(+)										
Principal's input to agent business (TRsqrt)	(+)									.043	.028
R^2		.036		.115		.116		.160 **		.179	
ΔR^2		.036		.078		.001		.045		.019	
ΔF		7.266 **		14.806 ***		.127		7.887 **		2.371	

195 case original dataset. n=195. † $p<.10$; * $p<.05$; ** $p<.01$; *** $p<.001$

Table 9-63. Dependency-based variable multiple regression results: Unstandardized coefficients (Imputed dataset)

		Control		Model 1		Model 2		Model 3		**Model 4**	
Variable	Hypoth.	Coef.	St.Er.	Coef.	St.Er.	Coef.	St.Er.	Coef.	St.Er.	**Coef.**	**St.Er.**
Intercept		2.008 ***	.288	2.135 ***	.280	2.104 ***	.308	2.049 ***	.276	2.080 ***	.275
Control Variables											
Firm size - Total DWT (TRlog10)		-.130 **	.048	-.141 **	.047	-.139 **	.047	-.154 **	.046	-.165 ***	.046
Power Imbalance (proxy)	H_{RDT1}(+)										
Principal's dependence on agents (TRlog10)	(-)			.201 ***	.051	.200 ***	.051	.181 ***	.051	.173 **	.051
Unilateral Power Restructuring Operations	H_{RDT2}(+)										
Resource internal. potential (difficulty) (TRsqrt)	(-)					.012	.052				
Bilateral Power Restructuring Operations	H_{RDT3}(+)										
Cooptation potential	(+)							.051 **	.017	.040 *	.018
Agent Actual Dependence	H_{RDT4}(+)										
Principal's input to agent business (TRsqrt)	(+)									.031 †	.018
R^2		.036		.108		.108		.147		.160	
ΔR^2		.036		.072		.000		.039		.014	
ΔF		7.266 **		15.399 ***		.057		8.669 **		3.089 †	

195 case imputed dataset. n=195. † $p<.10$; * $p<.05$; ** $p<.01$; *** $p<.001$

Table 9-64. Dependency-based variable multiple regr. results: Standardized coefficients (Original dataset)

		Control	Model 1	Model 2	**Model 3**	Model 4
Variable	Hypoth.	Coef.	Coef.	Coef.	**Coef.**	Coef.
Control Variables						
Firm size - Total DWT (TRlog10)		-.190 **	-.212 **	-.207 **	-.240 **	-.283 **
Power Imbalance (proxy)	H_{RDT1}(+)					
Principal's dependence on agents (TRlog10)	(-)		.281 ***	.283 ***	.247 **	.222 *
Unilateral Power Restructuring Operations	H_{RDT2}(+)					
Resource internal. potential (difficulty) (TRsqrt)	(-)			.028		
Bilateral Power Restructuring Operations	H_{RDT3}(+)					
Cooptation potential	(+)				.217 **	.124
Agent Actual Dependence	H_{RDT4}(+)					
Principal's input to agent business (TRsqrt)	(+)					.179
R^2		.036	.115	.116	.160	.179
ΔR^2		.036	.078	.001	.045	.019
ΔF		7.266 **	14.806 ***	.127	7.887 **	2.371

195 case original dataset. n=195. † p<.10; * p<.05; ** p<.01; *** p<.001

Table 9-65. Dependency-based variable multiple regr. results: Standardized coefficients (Imputed dataset)

		Control	Model 1	Model 2	Model 3	**Model 4**
Variable	Hypoth.	Coef.	Coef.	Coef.	Coef.	**Coef.**
Control Variables						
Firm size - Total DWT (TRlog10)		-.190 **	-.206 **	-.204 **	-.226 **	-.242 ***
Power Imbalance (proxy)	H_{RDT1}(+)					
Principal's dependence on agents (TRlog10)	(-)		.268 ***	.267 ***	.241 ***	.231 **
Unilateral Power Restructuring Operations	H_{RDT2}(+)					
Resource internal. potential (difficulty) (TRsqrt)	(-)			.017		
Bilateral Power Restructuring Operations	H_{RDT3}(+)					
Cooptation potential	(+)				.200 **	.157 *
Agent Actual Dependence	H_{RDT4}(+)					
Principal's input to agent business (TRsqrt)	(+)					.127 †
R^2		.036	.108	.108	.147	.160
ΔR^2		.036	.072	.000	.039	.014
ΔF		7.266 **	15.399 ***	.057	8.669 **	3.089 †

195 case imputed dataset. n=195. † p<.10; * p<.05; ** p<.01; *** p<.001

Model 1 indicates that the higher the principals' general dependence on agents is, the higher the level of outsourcing. Still bearing in mind that the particular variable does not include a counterpart for the agents' general dependence on principals, the finding is significant at the .01 level in both datasets offering an average unique explanation of 7.5% of the dependent outcome's variance in the two datasets. Model 2, simply indicates the insignificance of resource internalization potential in both datasets. Model 3 then, indicates that the higher the cooptation potential of principals over agents, the higher the level of activity outsourcing. The finding, significant at the .01 level in both datasets, offers an average unique explanation of 4.2% of the dependent's variance. Model 4, finally, which includes a quasi-counterpart to the principal's general dependence through the agents' actual dependence on principals, indicates that the higher the level of the latter dependence, the higher the level of activity outsourcing. The finding is significant at the .10 level only in the imputed dataset and offers an additional explanation of 1.4% of the outcome's variance. At this point, it should be noted that the imputed dataset has 91 estimated values for this variable that were previously missing. Given the above, Model 4 is cautiously retrieved as the parsimonious linear regression model for dependnecy-based variables with the inclusion of the agents' actual dependence.

9.6.4 Competence-based variable hierarchical multiple regression

With regard to the hierarchical entrance of competence-based considerations, the sequencing adopted in logistic regression is similarly followed here. Resource value considerations are entered first followed by the closely associated concept of potential resource value. Subsequently, natural resource scarcity is examined while, finally, the sequence is concluded by the consideration of resource inimitability concerns (including intrafirm and interfirm causal ambiguity as well as resource social complexity).

Tables 9-66 and 9-67 present the variable correlation matrices for the original and imputed 195 case datasets. Changes in correlation significance levels observed in the imputed dataset, are highlighted in Table 9-67. Tables 9-68 through 9-71, report the results of the multiple regression model-building process for the study's competence-based variables in the 195 case original (Tables 9-68 and 9-70) and imputed (Tables 9-69 and 9-71) dataset. Highlighted values here denote statistically significant results.

Table 9-66. Competence-based variable correlation matrix (195 case original dataset)

Variable	1	2	3	4	5	6	7	8
1 Activity Outsourcing (TRlog10)	1.000							
2 Contribution to higher gains	.040	1.000						
3 Contribution to lower costs	.061	.387 ***	1.000					
4 Potential resource value	.150 *	.768 ***	.702 ***	1.000				
5 Natural resource scarcity	.034	-.138	.042	-.053	1.000			
6 Intrafirm causal ambiguity	.121	-.013	-.003	-.010	.220 **	1.000		
7 Interfirm causal ambiguity	-.074	.095	.226 **	.024	.302 ***	-.270 **	1.000	
8 Resource social complexity (TRsqrt)	-.035	-.272 **	-.132	-.232 **	.098	-.044	.160 *	1.000

195 case original dataset. n=195. * p<.05; ** p<.01; *** p<.001

Table 9-67. Competence-based variable correlation matrix (195 case imputed dataset)

Variable	1	2	3	4	5	6	7	8
1 Activity Outsourcing (TRlog10)	1.000							
2 Contribution to higher gains	.060	1.000						
3 Contribution to lower costs	.022	.353 ***	1.000					
4 Potential resource value	.137 *	.726 ***	.608 ***	1.000				
5 Natural resource scarcity	.024	-.082	-.036	-.058	1.000			
6 Intrafirm causal ambiguity	.076	-.036	.036	-.001	.115	1.000		
7 Interfirm causal ambiguity	-.093	.086	.172 *	-.025	.235 **	-.231 **	1.000	
8 Resource social complexity (TRsqrt)	-.025	-.201 **	-.119	-.230 **	.032	-.058	.155 *	1.000

195 case imputed dataset. n=195. * p<.05; ** p<.01; *** p<.001

Table 9-68. Competence-based variable multiple regression results: Unstandardized coefficients (Original dataset)

		Control		Model 1		Model 2		**Model 3**		Model 4		Model 5	
Variable	Hypoth.	Coef.	St.Er.	Coef.	St.Er.	Coef.	St.Er.	**Coef.**	**St.Er.**	Coef.	St.Er.	Coef.	St.Er.
Intercept		2.008 ***	.288	1.968 ***	.324	1.951 ***	.323	1.819 ***	.326	1.778 ***	.341	1.754 ***	.424
Control Variables													
Firm size - Total DWT (TRlog10)		-.130 **	.048	-.129 *	.052	-.127 *	.051	-.117 *	.052	-.117 *	.053	-.130 *	.060
Resource Value I	H_{RBV1} (-)												
Contribution to higher gains	(-)			.005	.010								
Resource Value II	H_{RBV2} (-)												
Contribution to lower costs	(-)					.010	.020						
Potential Resource Value	H_{RBV3} (-)												
Potential contribution to gains or costs	(-)							.017 †	.010	.017 †	.011	.019 †	.012
Resource Scarcity	H_{RBV4} (-)												
Natural resource scarcity	(-)									.011	.020		
Resource Inimitability	H_{RBV5} (-)												
Intrafirm causal ambiguity	(-)											.018	.016
Interfirm causal ambiguity	(-)											-.020	.026
Resource social complexity (TRsqrt)	(-)											.036	.045
R^2		.036		.038		.038		.051		.053		.072	
ΔR^2		.036		.001		.001		.015		.002		.021	
ΔF		7.266 **		.221		.266		2.654 †		.304		1.018	

195 case original dataset. n=195. † p<.10; * p<.05; ** p<.01; *** p<.001

Table 9-69. Competence-based variable multiple regression results: Unstandardized coefficients (Imputed dataset)

		Control		Model 1		Model 2		**Model 3**		Model 4		Model 5	
Variable	Hypoth.	Coef.	St.Er.	Coef.	St.Er.	Coef.	St.Er.	**Coef.**	**St.Er.**	Coef.	St.Er.	Coef.	St.Er.
Intercept		2.008 ***	.288	1.947 ***	.298	2.010 ***	.306	1.849 ***	.301	1.819 ***	.311	1.879 ***	.360
Control Variables													
Firm size - Total DWT (TRlog10)		-.130 **	.048	-.129 **	.048	-.130 **	.049	-.122 *	.048	-.122 *	.048	-.127 *	.049
Resource Value I	H_{RBV1} (-)												
Contribution to higher gains	(-)			.008	.010								
Resource Value II	H_{RBV2} (-)												
Contribution to lower costs	(-)					.000	.018						
Potential Resource Value	H_{RBV3} (-)												
Potential contribution to gains or costs	(-)							.017 †	.010	.017 †	.010	.018 †	.010
Resource Scarcity	H_{RBV4} (-)												
Natural resource scarcity	(-)									.007	.018		
Resource Inimitability	H_{RBV5} (-)												
Intrafirm causal ambiguity	(-)											.009	.013
Interfirm causal ambiguity	(-)											-.027	.022
Resource social complexity (TRsqrt)	(-)											.025	.037
R^2		.036		.039		.036		.050		.051		.064	
ΔR^2		.036		.003		.000		.014		.001		.014	
ΔF		7.266 **		.633		.000		2.873 †		.170		.912	

195 case imputed dataset. n=195. † p<.10; * p<.05; ** p<.01; *** p<.001

Table 9-70. Competence-based variable multiple regression results: Standardized coefficients (Original dataset)

		Control	Model 1	Model 2	**Model 3**	Model 4	Model 5
Variable	Hypoth.	Coef.	Coef.	Coef.	**Coef.**	Coef.	Coef.
Control Variables							
Firm size - Total DWT (TRlog10)		-.190 **	-.190 *	-.186 *	-.171 *	-.171 *	-.190 *
Resource Value I	H_{RBV1} (-)						
Contribution to higher gains	(-)		.036				
Resource Value II	H_{RBV2} (-)						
Contribution to lower costs	(-)			.039			
Potential Resource Value	H_{RBV3} (-)						
Potential contribution to gains or costs	(-)				.123 †	.125 †	.139 †
Resource Scarcity	H_{RBV4} (-)						
Natural resource scarcity	(-)					.042	
Resource Inimitability	H_{RBV5} (-)						
Intrafirm causal ambiguity	(-)						.101
Interfirm causal ambiguity	(-)						-.069
Resource social complexity (TRsqrt)	(-)						.071
R^2		.036	.038	.038	.051	.053	.072
ΔR^2		.036	.001	.001	.015	.002	.021
ΔF		7.266 **	.221	.266	2.654 †	.304	1.018

195 case original dataset. n=195. † p<.10; * p<.05; ** p<.01; *** p<.001

Table 9-71. Competence-based variable multiple regression results: Standardized coefficients (Imputed dataset)

		Control	Model 1	Model 2	**Model 3**	Model 4	Model 5
Variable	Hypoth.	Coef.	Coef.	Coef.	**Coef.**	Coef.	Coef.
Control Variables							
Firm size - Total DWT (TRlog10)		-.190 **	-.189 **	-.191 **	-.179 *	-.178 *	-.186 *
Resource Value I	H_{RBV1} (-)						
Contribution to higher gains	(-)		.056				
Resource Value II	H_{RBV2} (-)						
Contribution to lower costs	(-)			-.001			
Potential Resource Value	H_{RBV3} (-)						
Potential contribution to gains or costs	(-)				.120 †	.121 †	.128 †
Resource Scarcity	H_{RBV4} (-)						
Natural resource scarcity	(-)					.029	
Resource Inimitability	H_{RBV5} (-)						.048
Intrafirm causal ambiguity	(-)						-.092
Interfirm causal ambiguity	(-)						.050
Resource social complexity (TRsqrt)	(-)						
R^2		.036	.039	.036	.050	.051	.064
ΔR^2		.036	.003	.000	.014	.001	.014
ΔF		7.266 **	.633	.000	2.873 †	.170	.912

195 case imputed dataset. n=195. † p<.10; * p<.05; ** p<.01; *** p<.001

Models 1 and 2 indicate that resource value (as represented by an activity's contributions to higher gains and lower costs respectively) does not bear any influence over an activity's outsourcing levels. Model 3, on the other hand, indicates that the higher the potential contribution of an activity to either higher gains or lower costs in the future is, the higher the level of activity outsourcing. The finding is significant at the .10 level on both datasets and offers an average unique explanation of merely 1.45% of the variance in outsourcing levels. Subsequently, Models 4 and 5 indicate in both datasets that neither natural resource scarcity nor resource inimitability concerns bear any influence on an activity's outsourcing levels once the decision to outsource has been made. As such, Model 3 is precariously elected as the parsimonious linear regression model for competence-based variables as change in the F statistic over the control model was barely significant at the .10 level (sig. .092).

9.6.5 Identity-based variable hierarchical multiple regression

Identity-based considerations conclude the study's compartmental exploration of strategic perspectives through multiple regression analyses. With regard to the variables' entrance sequence, the construct of resource-identity coherence is entered first as the only principle hypothesis of this perspective. Sourcing influences imposed by the empirical context's institutional forces are entered next while the sequence concludes with the consideration of influences deriving from competitive industrial forces.

Tables 9-72 and 9-73 present the variable correlation matrices for the original and imputed 195 case datasets (with a limited number of data points imputed only in the resource-identity coherence variable). Changes in correlation significance levels observed in the imputed dataset, are highlighted in Table 9-73. Tables 9-74 through 9-77, report the results of the multiple regression model-building process for the study's competence-based variables in the 195 case original (Tables 9-74 and 9-76) and imputed (Tables 9-75 and 9-77) dataset. Highlighted values here denote statistically significant results.

Table 9-72. Identity-based variable correlation matrix (195 case original dataset)

Variable	1	2	3	4
1 Activity Outsourcing (TRlog10)	1.000			
2 Resource-identity coherence	-.016	1.000		
3 Institutional forces influence	.023	.297 ***	1.000	
4 Industrial forces influence	.006	.259 ***	.408 ***	1.000

195 case original dataset. n=195. * p<.05; ** p<.01; *** p<.001

Table 9-73. Identity-based variable correlation matrix (195 case imputed dataset)

Variable	1	2	3	4
1 Activity Outsourcing (TRlog10)	1.000			
2 Resource-identity coherence	-.046	1.000		
3 Institutional forces influence	.023	.249 ***		
4 Industrial forces influence	.006	.224 **	.408 ***	1.000

195 case imputed dataset. n=195. * p<.05; ** p<.01; *** p<.001

Table 9-74. Identity-based variable multiple regression results: Unstandardized coefficients (Original dataset)

		Control		Model 1		Model 2		Model 3	
Variable	Hypoth.	Coef.	St.Er.	Coef.	St.Er.	Coef.	St.Er.	Coef.	St.Er.
Intercept		2.008 ***	.288	2.111 ***	.346	2.027 ***	.347	2.000 ***	.295
Control Variables									
Firm size - Total DWT (TRlog10)		-.130 **	.048	-.134 **	.050	-.131 **	.049	-.130 **	.048
Resouce-Identity Coherence	H_{OIC1} (-)								
Alignment of activity with identity	(-)			-.016	.029				
Institutional Forces Influence	H_{OIC2} (±)								
Institutional forces degree of infuence	(±)					-.003	.029		
Industrial Forces Influence	H_{OIC3} (±)								
Indutrial forces degree of infuence	(±)							.002	.020
R^2		.036		.038		.036		.036	
ΔR^2		.036		.002		.000		.000	
ΔF		7.266 **		.325		.010		.016	

195 case original dataset. n=195. † p<.10; * p<.05; ** p<.01; *** p<.001

Table 9-75. Identity-based variable multiple regression results: Unstandardized coefficients (Imputed dataset)

		Control		Model 1		Model 2		Model 3	
Variable	Hypoth.	Coef.	St.Er.	Coef.	St.Er.	Coef.	St.Er.	Coef.	St.Er.
Intercept		2.008 ***	.288	2.186 ***	.337	2.027 ***	.347	2.000 ***	.295
Control Variables									
Firm size - Total DWT (TRlog10)		-.130 **	.048	-.137 **	.049	-.131 **	.049	-.130 **	.048
Resouce-Identity Coherence	H_{OIC1} (-)								
Alignment of activity with identity	(-)			-.028	.028				
Institutional Forces Influence	H_{OIC2} (±)								
Institutional forces degree of infuence	(±)					-.003	.029		
Industrial Forces Influence	H_{OIC3} (±)								
Indutrial forces degree of infuence	(±)							.002	.020
R^2		.036		.041		.036		.036	
ΔR^2		.036		.005		.000		.000	
ΔF		7.266 **		1.029		.010		.016	

195 case imputed dataset. n=195. † p<.10; * p<.05; ** p<.01; *** p<.001

Table 9-76. Identity-based variable multiple regr. results: Standardized coefficients (Original dataset)

		Control	Model 1	Model 2	Model 3
Variable	Hypoth.	Coef.	Coef.	Coef.	Coef.
Control Variables					
Firm size - Total DWT (TRlog10)		-.190 **	-.196 **	-.192 **	-.191 **
Resouce-Identity Coherence	H_{OIC1} (-)				
Alignment of activity with identity	(-)		-.042		
Institutional Forces Influence	H_{OIC2} (±)				
Institutional forces degree of infuence	(±)			-.007	
Industrial Forces Influence	H_{OIC3} (±)				
Indutrial forces degree of infuence	(±)				.009
R^2		.036	.038	.036	.036
ΔR^2		.036	.002	.000	.000
ΔF		7.266 **	.325	.010	.016

195 case original dataset. n=195. † p<.10; * p<.05; ** p<.01; *** p<.001

Table 9-77. Identity-based variable multiple regr. results: Standardized coefficients (Imputed dataset)

		Control	Model 1	Model 2	Model 3
Variable	Hypoth.	Coef.	Coef.	Coef.	Coef.
Control Variables					
Firm size - Total DWT (TRlog10)		-.190 **	-.200 **	-.192 **	-.191 **
Resouce-Identity Coherence	H_{OIC1} (-)				
Alignment of activity with identity	(-)		-.072		
Institutional Forces Influence	H_{OIC2} (±)				
Institutional forces degree of infuence	(±)			-.007	
Industrial Forces Influence	H_{OIC3} (±)				
Indutrial forces degree of infuence	(±)				.009
R^2		.036	.041	.036	.036
ΔR^2		.036	.005	.000	.000
ΔF		7.266 **	1.029	.010	.016

195 case imputed dataset. n=195. † p<.10; * p<.05; ** p<.01; *** p<.001

A browsing of the results tables indicates that identity-based concerns bear no influence on the level of an activity's outsourcing levels once the decision to outsource is made (no significant change was detected in each of the three models' F statistic).

9.6.6 A multi-theoretic approach through multiple regression analysis

In concluding this section presenting the results of hierarchical multiple regression analyses, a multi-theoretic or otherwise a combined-perspective approach is offered by the examination of a number of models where the various perspectives' statistically significant findings are combined. In essence, this meta-analysis aims at investigating whether such an approach to the explanation of a maintenance activity's outsourcing levels yields superior results when compared to the consideration of each perspective individually.

As such, the control variable of firm size along with the variables of behavioural uncertainty, the principals' asset specificity, the principals' dependence on agents, the principals' cooptation potential, the agents' actual dependence on principals and potential resource value are combined in three standard logistic regression models each run on both the original as well as imputed 195 case datasets.

The first model includes all of the variables in the imputed dataset while the variable of agents' actual dependence is excluded in the original dataset run as it was not found significant in the first place. The second model excludes the agents' actual dependence as well as the potential resource value variables, the former due to missing and imputed value concerns and the latter due to its marginal original significance. The third model, finally, aims at the formation of the most economical model possible, and thus further excludes statistically non-significant component variables of the principals' asset specificity concerns.

Tables 9-78 and 9-79 present the assorted variables' correlation matrices for the original and imputed 195 case datasets. Changes in correlation significance levels observed in the imputed dataset, are highlighted in Table 9-79. Tables 9-80 through 9-83, then report the results of the scheduled standard multiple regression analyses performed in the 195 case original (Tables 9-80 and 9-82) and imputed (Tables 9-81 and 9-83) dataset. Highlighted values here denote statistically significant results.

Table 9-78. Multi-theoretic variable correlation matrix (195 case original dataset)

Variable	1	2	3	4	5	6	7	8	9	10	11
1 Activity Outsourcing (TRlog10)	1.000										
2 Behavioural uncertainty (unreliability)	-.216 **	1.000									
3 Principal's human asset specificity (TRsqrt)	-.054	.041	1.000								
4 Principal's physical asset specificity (TRsqrt)	.099	.023	.589 ***	1.000							
5 Principal's dedicated asset specificity (TRsqrt)	.266 ***	-.122	.529 ***	.573 ***	1.000						
6 Principal's procedural asset specificity (TRsqrt)	.055	.074	.707 ***	.791 ***	.582 ***	1.000					
7 Principal's temporal specificity (TRsqrtRflct)	.102	-.166 *	.068	.036	-.029	.036	1.000				
8 Principal's dependence on agents (TRlog10)	.265 ***	-.268 **	-.020	.219 **	.177 *	.165 *	.053	1.000			
9 Cooptation potential	.224 **	-.229 **	.109	.081	.396 ***	.120	-.041	.165* *	1.000		
10 Principal's input to agent business (TRsqrt)	.214 *	-.163	.016	.003	.314 **	-.005	-.058	.247 **	.575 ***	1.000	
11 Potential resource value	.150 *	-.154 *	.055	.058	.357 ***	.066	-.239 **	.023	.435 ***	.072	1.000

195 case original dataset. n=195. * p<.05; ** p<.01; *** p<.001

Table 9-79. Multi-theoretic variable correlation matrix (195 case imputed dataset)

Variable	1	2	3	4	5	6	7	8	9	10	11
1 Activity Outsourcing (TRlog10)	1.000										
2 Behavioural uncertainty (unreliability)	-.211 **	1.000									
3 Principal's human asset specificity (TRsqrt)	-.026	.051	1.000								
4 Principal's physical asset specificity (TRsqrt)	.100	.046	.577 ***	1.000							
5 Principal's dedicated asset specificity (TRsqrt)	.238 **	-.080	.511 ***	.567 ***	1.000						
6 Principal's procedural asset specificity (TRsqrt)	.021	.102	.663 ***	.767 ***	.580 ***	1.000					
7 Principal's temporal specificity (TRsqrtRflct)	.108	-.159 *	.058	.059	-.020	.043	1.000				
8 Principal's dependence on agents (TRlog10)	.256 ***	-.236 **	.025	.194 **	.111	.112	.046	1.000			
9 Cooptation potential	.210 **	-.161 *	.131	.094	.374 ***	.144 *	-.046	.141 *	1.000		
10 Principal's input to agent business (TRsqrt)	.174 *	-.088	.077	-.051	.165 *	.026	-.056	.135	.360 ***	1.000	
11 Potential resource value	.137	-.141 *	.045	.023	.296 ***	.023	-.231 **	.041	.400 ***	.021	1.000

195 case imputed dataset. n=195. * p<.05; ** p<.01; *** p<.001

Table 9-80. Multi-theoretic variable multiple regression results: Unstandardized coefficients (Original dataset)

		Control		Model 1		Model 2		Model 3	
Variable	Hypoth.	Coef.	St.Er.	Coef.	St.Er.	Coef.	St.Er.	Coef.	St.Er.
Intercept		2.008 ***	.288	1.724 ***	.399	1.727 ***	.371	1.881 ***	.338
Control Variables									
Firm size - Total DWT (TRlog10)		-.130 **	.048	-.102 †	.058	-.102 †	.057	-.108 †	.056
Behavioural Uncertainty	H_{TCE1}(-)								
Unreliability of suppliers	(-)			-.027	.033	-.027	.033	-.033	.032
Principal's Asset Specificity	H_{TCE2}(-)								
Principal's human asset specificity (TRsqrt)	(-)			-.148 †	.086	-.148 †	.086	-.134 †	.070
Principal's physical asset specificity (TRsqrt)	(-)			.039	.094	.039	.093	-	-
Principal's dedicated asset specificity (TRsqrt)	(-)			.195 *	.096	.196 *	.094	.194 *	.085
Principal's procedural asset specificity (TRsqrt)	(-)			-.023	.107	-.023	.107	-	-
Principal's temporal specificity (TRsqrtRflct)	(+)			.063	.057	.063	.055	-	-
Power Imbalance (proxy)	H_{RDT1}(+)								
Principal's dependence on agents (TRlog10)	(-)			.131 *	.061	.131 *	.061	.138 *	.058
Bilateral Power Restructuring Operations	H_{RDT3}(+)								
Cooptation potential	(+)			.034	.025	.034	.023	.032	.023
Agent Actual Dependence	H_{RDT4}(+)								
Principal's input to agent business (TRsqrt)	(+)			-	-	-	-	-	-
Potential Resource Value	H_{RBV3}(-)								
Potential contribution to gains or costs	(-)			.000	.013	-	-	-	-
R^2		.036		.216		.207		.198	
ΔR^2		.036		.216		.207		.198	
ΔF		7.266 **		2.201 *		3.790 ***		5.817 ***	

195 case original dataset. n=195. † p<.10; * p<.05; ** p<.01; *** p<.001

Table 9-81. Multi-theoretic variable multiple regression results: Unstandardized coefficients (Imputed dataset)

		Control		Model 1		Model 2		Model 3	
Variable	Hypoth.	Coef.	St.Er.	Coef.	St.Er.	Coef.	St.Er.	Coef.	St.Er.
Intercept		2.008 ***	.288	1.788 ***	.329	1.796 ***	.313	1.937 ***	.289
Control Variables									
Firm size - Total DWT (TRlog10)		-.130 **	.048	-.124 *	.048	-.112 *	.047	-.117 *	.047
Behavioural Uncertainty	H_{TCE1} (-)								
Unreliability of suppliers	(-)			-.029	.028	-.031	.028	-.040	.027
Principal's Asset Specificity	H_{TCE2} (-)								
Principal's human asset specificity (TRsqrt)	(-)			-.103	.068	-.094	.068	-.107 †	.058
Principal's physical asset specificity (TRsqrt)	(-)			.105	.081	.078	.081	-	-
Principal's dedicated asset specificity (TRsqrt)	(-)			.163 *	.082	.189 *	.079	.177 *	.071
Principal's procedural asset specificity (TRsqrt)	(-)			-.105	.088	-.106	.088	-	-
Principal's temporal specificity (TRsqrtRflct)	(+)			.070	.049	.062	.048	-	-
Power Imbalance (proxy)	H_{RDT1} (+)								
Principal's dependence on agents (TRlog10)	(-)			.137 *	.053	.148 **	.053	.154 **	.051
Bilateral Power Restructuring Operations	H_{RDT3} (+)								
Cooptation potential	(+)			.021	.021	.034 †	.019	.031 †	.019
Agent Actual Dependence	H_{RDT4} (+)								
Principal's input to agent business (TRsqrt)	(+)			.033 †	.018	-	-	-	-
Potential Resource Value	H_{RBV3} (-)								
Potential contribution to gains or costs	(-)			.005	.011	-	-	-	-
R^2		.036		.215		.200		.186	
ΔR^2		.036		.215		.200		.186	
ΔF		7.266 **		4.567 ***		5.153 ***		7.171 ***	

195 case imputed dataset. n=195. † p<.10; * p<.05; ** p<.01; *** p<.001

Table 9-82. Multi-theoretic variable multiple regr. results: Standardized coefficients (Original dataset)

		Control	Model 1	Model 2	Model 3
Variable	Hypoth.	Coef.	Coef.	Coef.	Coef.
Control Variables					
Firm size - Total DWT (TRlog10)		-.190 **	-.149 †	-.149 †	-.158 †
Behavioural Uncertainty	H_{TCE1} (-)				
Unreliability of suppliers	(-)		-.068	-.068	-.083
Principal's Asset Specificity	H_{TCE2} (-)				
Principal's human asset specificity (TRsqrt)	(-)		-.196 †	-.196 †	-.177 †
Principal's physical asset specificity (TRsqrt)	(-)		.054	.054	-
Principal's dedicated asset specificity (TRsqrt)	(-)		.241 *	.241 *	.239 *
Principal's procedural asset specificity (TRsqrt)	(-)		-.031	-.032	-
Principal's temporal specificity (TRsqrtRflct)	(+)		.090	.089	-
Power Imbalance (proxy)	H_{RDT1} (+)				
Principal's dependence on agents (TRlog10)	(-)		.179 *	.179 *	.189 *
Bilateral Power Restructuring Operations	H_{RDT3} (+)				
Cooptation potential	(+)		.129	.129	.121
Agent Actual Dependence	H_{RDT4} (+)				
Principal's input to agent business (TRsqrt)	(+)		-	-	-
Potential Resource Value	H_{RBV3} (-)				
Potential contribution to gains or costs	(-)		.001	-	-
R^2		.036	.207	.207	.198
ΔR^2		.036	.207	.207	.198
ΔF		7.266 **	3.345 **	3.790 ***	5.817 ***

195 case original dataset. n=195. † p<.10; * p<.05; ** p<.01; *** p<.001

Table 9-83. Multi-theoretic variable multiple regr. results: Standardized coefficients (Imputed dataset)

		Control	Model 1	Model 2	Model 3
Variable	Hypoth.	Coef.	Coef.	Coef.	Coef.
Control Variables					
Firm size - Total DWT (TRlog10)		-.190 **	-.182 *	-.164 *	-.171 *
Behavioural Uncertainty	H_{TCE1} (-)				
Unreliability of suppliers	(-)		-.073	-.079	-.102
Principal's Asset Specificity	H_{TCE2} (-)				
Principal's human asset specificity (TRsqrt)	(-)		-.138	-.126	-.143 †
Principal's physical asset specificity (TRsqrt)	(-)		.142	.106	-
Principal's dedicated asset specificity (TRsqrt)	(-)		.195 *	.226 *	.212 *
Principal's procedural asset specificity (TRsqrt)	(-)		-.139	-.140	-
Principal's temporal specificity (TRsqrtRflct)	(+)		.099	.088	-
Power Imbalance (proxy)	H_{RDT1} (+)				
Principal's dependence on agents (TRlog10)	(-)		.183 *	.197 **	.205 **
Bilateral Power Restructuring Operations	H_{RDT3} (+)				
Cooptation potential	(+)		.084	.133 †	.123 †
Agent Actual Dependence	H_{RDT4} (+)				
Principal's input to agent business (TRsqrt)	(+)		.137 †	-	-
Potential Resource Value	H_{RBV3} (-)				
Potential contribution to gains or costs	(-)		.037	-	-
R^2		.036	.215	.200	.186
ΔR^2		.036	.215	.200	.186
ΔF		7.266 **	4.567 ***	5.153 ***	7.171 ***

195 case imputed dataset. n=195. † p<.10; * p<.05; ** p<.01; *** p<.001

The results of the multi-theoretic multiple regression model runs indicate that certain interaction effects among the variables cause some of them to lose their significant result status. Notably, behavioural uncertainty borderlines in the non-significant side along all of the models mainly due to the cooptation potential variable (interaction tested in a separate model run). As anticipated, the agents' actual dependence variable is only significant in the original dataset while potential resource value was no longer found significant throughout the models (due to interactions with the principals' dedicated asset specificity variable). Other than the aforementioned notes, the variables behaved in a way similar to that exhibited in the perspective-specific model runs.

The best fitting models in the individual examination of each perspective are Model 2, formed in the investigation of efficiency–based considerations, and Model 3 developed through dependency-based considerations. The models respectively explain 16.8% and 16% of the dependent's variance in the original datasets along with 14.8% and 14.7% in the imputed dataset. In comparison, the most economical of the multi-theoretic linear regression models (i.e. Model 3) offers an explanation of 19.8% of the dependent variable's variables in the original dataset and 18.6% in the imputed dataset.

While the combined-perspective approach in this case is largely an efficiency and dependency-based consideration affair, in view of the aforementioned findings, it is put forth that a multi-theoretic approach to the explanation of maintenance activity outsourcing levels is preferable to the consideration of singular perspectives in separation. At the same time, however, it is also indicated that the considerations provided by the articulation of the different strategic perspectives through the elected theoretical frameworks (i.e. TCE, RDT, RBV and OIC), account for a relatively small amount of the variance exhibited in the dependent outcome. As a result, further research into the issue through alternative combined-perspective approaches is advised.

Chapter 10

Discussion, implications and recommendations

10.1 Introduction

This chapter provides a concluding discussion of the study's findings and related implications both from a theoretical as well as a practical perspective. Furthermore, the chapter addresses the study's limitations and caveats all the while offering recommendations for further research in the particular phenomenon of interest..

10.2 Summary of findings

This section summarizes the findings of the study's empirical research with regard to the support of hypotheses formed within each of the strategic perspectives explored in the study. In particular, the section reiterates and systematizes the findings of analyses conducted on empirical data collected through a quasi-experimental cross-sectional survey performed in the deep-sea marine shipping sector. The findings are based on the results of a series of hierarchical logistic and multiple linear regression statistical analyses designed to explore the study's hypotheses. In reporting the empirical study's findings, focus is primarily put on the impact of strategic considerations on focal firms' decisions to outsource or not activities commonly targeted by servitization initiatives. Secondly, focus is put on the impact of considerations to the outsourcing level of said maintenance activities once the decision to outsource has been made. The reason for this dual and progressive analysis approach is that the servitization initiatives of interest in this study, i.e. performance-based contracts, not only aspire to elicit the outsourcing of activities on behalf of potential customers but further aim that said outsourcing is performed to an increased degree (i.e. with as much of an activity's performance and responsibility attributes being outsourced).

10.2.1 Findings on the decision to outsource an activity

To organize and summarily present the study's findings with regard to the support of the a priori hypothesized relationships between the various considerations and the likelihood that an activity is decided to be outsourced, a series of summary results tables is offered.

Each table includes the direction of the a priori hypothesized relationships denoted either as (+), (-) or (±). The (+) symbol indicates that as a consideration's magnitude, level or degree (in accordance to the operationalized measures used in each case) increases, so does the likelihood that the activity is outsourced. The (-) symbol, accordingly, indicates that as a consideration's magnitude level or degree increases, the likelihood that the activity is outsourced decreases. The (±) symbol, finally, indicates that no particular directionality is hypothesized a priori, apart from the expectation of a significant relationship with the likelihood that an activity is outsourced or not. Afterwards, the same set of symbols is used to denote the actual relationship that emerges through the data analysis processes of the study.

Furthermore, by comparing the a priori hypothesized relationships with the ones observed (or not, in many cases), each of the study's original hypotheses is characterized within the table as: (1) 'Supported', if there is a significant relationship detected and the direction of the observed relationship is in agreement with the a priori hypothesized direction, (2) 'Contradicted', if there is a significant relationship detected but the direction of the observed relationship is opposite to the one expected and finally (3) 'Not supported' if no significant relationship is found.

Each table, finally, concludes with an indication of the effect size of relationships that are found to be statistically significant. The measure used to proxy effect size, in this set of results, is the mean odds ratio of a consideration's variable at the hierarchical model where the variable was first entered in the regression equation and was found significant. In utilizing the aforementioned measure, it should be emphasized that the odds ratios of different considerations are not directly comparable to each other as they relate to different unit changes and different regression models. Rather, what is of interest in these measures is their deviation from one. Odds ratios closer to one indicate smaller or negligible effect sizes while ratios further away from one (on either side) indicate larger or noteworthy effect sizes.

Control variable findings

Table 10-1 presents the summary of findings with regard to the study's control variables. As indicated in the findings, none of the a priori hypothesized relationships were found to be significant. As such, the hypothesized relationships (even though not formally articulated as theoretical hypotheses) are not supported. Thus, the conclusion at this point is simply that a firm's size, a firm's age and a firm's average age of ships owned or controlled do not significantly influence the sourcing state of a focal maintenance activity.

Table 10-1. Findings on the impact of control variables on the decision to outsource

Considerations and associated variable(s)	Hypothesized relationship	Relationship found	Hypothesis status	Effect size [1]
Firm Size				
Firm size - Total DWT (TRlog10)	(±)	n/s [2]	Not supported	
Firm Age				
Firm Age (TRsqrt)	(±)	n/s	Not supported	
Firm Average Ship Age				
Average Ship Age (TRsqrt)	(±)	n/s	Not supported	

[1] Approximated by the variable's mean odds ratio in the regression model of initial entrance. Not comparable
[2] n/s: not significant relationship.

Efficiency-based considerations findings

Subsequently, focus is put on one of the more populous of the strategic perspectives that is the one occupied by efficiency considerations. Table 10-2 presents the summary of findings with regard to this perspective. At this point, it should be noted that while the study's formal hypotheses are sometimes articulated at the aggregated level of the overarching construct involved (e.g. principal's asset specificity), whenever multiple components are examined, the hypotheses are disaggregated and specified independently for each of the overarching construct's components. The disaggregated hypotheses normally follow the direction specified by the overarching construct hypothesis. The direction is reversed only in cases where an associated variable has been reflected for the needs of the analysis.

As seen on the relevant summary findings table, a noteworthy number of hypotheses stemming from efficiency-based considerations are not supported. These include H_{TCE1} with regard to the role of behavioural uncertainty, a significant portion of H_{TCE2} related to the principals' asset specificity overarching consideration, H_{TCE3} with regard to principals' proprietary asset exposure, the entirety of H_{TCE4} referring to the agents' asset specificity, one of the components of H_{TCE5} dealing with agents' proprietary asset exposure and H_{TCE8} with regard to the role of principals' value assessment ability.

Table 10-2. Findings on the impact of efficiency considerations on the decision to outsource

Considerations and associated variable(s)	Hypothesized relationship	Relationship found	Hypothesis status	Effect size [1]
Behavioural Uncertainty	H_{TCE1} (-)			
Unreliability of suppliers	(-)	n/s [2]	Not supported	
Principal's Asset Specificity	H_{TCE2} (-)			
Principal's human asset specificity (TRsqrt)	(-)	n/s	Not supported	
Principal's physical asset specificity (TRsqrt)	(-)	n/s	Not supported	
Principal's dedicated asset specificity (TRsqrt)	(-)	n/s	Not supported	
Principal's procedural asset specificity (TRsqrt)	(-)	(+)	Contradicted	1.730
Principal's temporal specificity (TRsqrtRflct)	(+)	(+)	Supported	1.474
Principal's Proprietary Asset Exposure	H_{TCE3} (-)			
Principal's brand capital exposure (TRsqrtRflct)	(+)	n/s	Not supported	
Principal's proprietary info exposed (TRsqrt)	(-)	n/s	Not supported	
Agent's Asset Specificity	H_{TCE4} (+)			
Agent's human asset specificity	(+)	n/s	Not supported	
Agent's physical asset specificity	(+)	n/s	Not supported	
Agent's dedicated asset specificity	(+)	n/s	Not supported	
Agent's procedural asset specificity	(+)	n/s	Not supported	
Agent's temporal asset specificity	(+)	n/s	Not supported	
Agent's Proprietary Assest Exposure	H_{TCE5} (+)			
Agent's brand name capital exposure	(+)	n/s	Not supported	
Agent's proprietary info exposed (TRsqrt)	(+)	(+)	Supported	1.547
Volume Uncertainty	H_{TCE6} (-)			
Difficulty to predict demand volume	(-)	(+)	Contradicted	1.403
Technological Uncertainty	H_{TCE7} (-)			
Speed x unpredictability of tech. devel. (TRsqrt)	(-)	(+)	Contradicted	1.294
Value Assessment Ability	H_{TCE8} (+)			
Ease of pricing tasks in the activity	(+)	n/s	Not supported	
Contribution Assessment Ability	H_{TCE9} (+)			
Ease of supplier performance evaluation	(+)	(-)	Contradicted	.814
Transaction Frequency	H_{TCE10} (-)			
Frequency of utilizing the transaction	(-)	(-)	Supported	.878

[1] Approximated by the variable's mean odds ratio in the regression model of initial entrance. Not comparable
[2] n/s: not significant relationship.

Furthermore, a number of hypotheses are contradicted in terms of their directionality when compared to the influence direction observed in the empirical data. Specifically, these include the principals' procedural asset specificity component consideration of H_{TCE2}, H_{TCE6} with regard to the influence of volume uncertainty, H_{TCE7} regarding the influence of technological uncertainty and H_{TCE9} dealing with principals' contribution assessment ability.

Finally, a limited number of hypotheses are fully supported by the study's empirical data analysis. These include the principals' temporal asset specificity component consideration of H_{TCE2}, the agents' proprietary information exposed component consideration of H_{TCE5}, and H_{TCE10} dealing with the concern of transaction frequency.

Dependency-based considerations findings

Table 10-3 offers the summary of findings with regard to the study's dependency-based considerations. As witnessed in the relevant table, none the hypotheses formulated within this particular strategic perspective is supported by significant and concurring findings. Hypotheses not supported include the principals' dependence on agents proxy consideration of H_{RDT1}, H_{RDT3} regarding the principals' cooptation potential and H_{RDT4} dealing with the consideration of agents' actual dependence on principals. Finally, H_{RDT2} relating to the principals' resource (i.e. activity) internalization potential (here operationalized as difficulty) is contradicted by the empirical observations.

Table 10-3. Findings on the impact of dependency considerations on the decision to outsource

Considerations and associated variable(s)	Hypothesized relationship	Relationship found	Hypothesis status	Effect size [1]
Power Imbalance (proxy)	H_{RDT1} (+)			
Principal's dependence on agents (TRlog10)	(-)	n/s[2]	Not supported	
Unilateral Power Restructuring Operations	H_{RDT2} (+)			
Resource internal. potential (difficulty) (TRsqrt)	(-)	(+)	Contradicted	1.618
Bilateral Power Restructuring Operations	H_{RDT3} (+)			
Cooptation potential	(+)	n/s	Not supported	
Agent Actual Dependence	H_{RDT4} (+)			
Principal's input to agent business (TRsqrt)	(+)	n/s	Not supported	

[1] Approximated by the variable's mean odds ratio in the regression model of initial entrance. Not comparable
[2] n/s: not significant relationship.

Competence-based considerations findings

Table 10-4 presents the summary of findings with regard to the study's competence-based considerations. Once again, none of the hypotheses formulated within the specific strategic perspective is supported by significant and concurring findings. Hypotheses not supported include H_{RBV2} with regard to an activity's contribution to lower costs, H_{RBV3} referring to an activity's potential future value and the interfirm causal ambiguity component consideration of H_{RBV5}.

Table 10-4. Findings on the impact of competence considerations on the decision to outsource

Considerations and associated variable(s)	Hypothesized relationship	Relationship found	Hypothesis status	Effect size [1]
Resource Value I	H_{RBV1} (-)			
Contribution to higher gains	(-)	(+)	Contradicted	1.075
Resource Value II	H_{RBV2} (-)			
Contribution to lower costs	(-)	n/s[2]	Not supported	
Potential Resource Value	H_{RBV3} (-)			
Potential contribution to gains or costs	(-)	n/s	Not supported	
Natural Resource Scarcity	H_{RBV4} (-)			
Difficulty of recruitment	(-)	(+)	Contradicted	1.355
Resource Inimitability	H_{RBV5} (-)			
Intrafirm causal ambiguity	(-)	(+)	Contradicted	1.155
Interfirm causal ambiguity	(-)	n/s	Not supported	
Resource social complexity (TRsqrt)	(-)	(+)	Contradicted	1.334

[1] Approximated by the variable's mean odds ratio in the regression model of initial entrance. Not comparable
[2] n/s: not significant relationship.

Interestingly, a number of hypotheses are contradicted by the study's empirical analyses. These include H_{RBV1} with regard to an activity's contribution to higher gains, H_{RBV4} referring to an activity's natural scarcity as well as the intrafirm causal ambiguity and resource social complexity component considerations of H_{RBV5}. In relation to H_{RBV1}, it should further be noted that the observed influence's effect size (near one) limits the importance of the occurring contradiction.

Identity-based considerations findings

Table 10-5 reports the summary of findings with regard to the study's identity-based considerations. As seen in the table, none of the hypotheses associated with the perspective seem to be supported by the empirical data. Nevertheless, as pointed out also in the data analysis chapter's relevant regression model runs, resource-identity coherence exhibits the expected directionality with a noticeable effect size. The result, however, is not statistically significant as there is a 25.5% chance that the finding is attributed to randomness.

Table 10-5. Findings on the impact of identity considerations on the decision to outsource

Considerations and associated variable(s)	Hypothesized relationship	Relationship found	Hypothesis status	Effect size (1)
Resouce-Identity Coherence	H_{OIC1} (-)			
Alignment of activity with identity	(-)	n/s (2)	Not supported	
Institutional Forces Influence	H_{OIC2} (±)			
Institutional forces degree of infuence	(±)	n/s	Not supported	
Industrial Forces Influence	H_{OIC3} (±)			
Indutrial forces degree of infuence	(±)	n/s	Not supported	

(1) Approximated by the variable's mean odds ratio in the regression model of initial entrance. Not comparable
(2) n/s: not significant relationship.

Logistic regression model goodness of fit indicators

A final issue addressed in this summary of findings for the logistic regression models which aim at the explanation of firm boundary decisions to outsource a maintenance activity or not, is model fit. While the relevant goodness of fit indicators have been presented in detail in the previous chapter for all the models run, it is deemed prudent to reiterate here the same indicators for the parsimonious models of each strategic perspective in a comparative manner. A parsimonious model is the one that includes all of the considerations found to be statistically significant during the relevant model-building processes. For reference purposes, model fit indicators of the most economical combined-perspective model are also reported. Table 10-6 presents the summary of the relevant findings.

Table 10-6. Logistic regr. model goodness of fit indicators of the strategic considerations

Parsimonious model of	Variables included in model (df)	Model χ^{2} (1)	Pseudo-variance explained (2)	Percentage of cases classified correctly (%) (3)
Control variables	-	-	-	-
Efficiency considerations	11	52.635	.182	65.3
Dependency considerations	1	7.183	.026	53.9
Competence considerations	5	37.293	.132	63.6
Identity considerations	-	-	-	-
Combined-perspective model	12	66.394	.225	68.1

(1) Log-likelihood difference between full and intercept-only model: 2[LL(B)-LL(0)]
(2) Nagelkerke's R^2 (generalized analogue to explained variance)
(3) Baseline correct classification reference of intercept-only model at 54.2 (%)

10.2.2 Findings on the level of activity outsourcing

To organize and summarily present the study's findings with regard to the support of the a priori hypothesized relationships between the various considerations and the level of outsourcing observed in a maintenance activity once the decision to outsource has been made, a further series of summary results tables is offered.

Each table includes the direction of the a priori hypothesized relationships denoted either as (+), (-) or (±). The (+) symbol indicates that as a consideration's magnitude, level or degree increases, the level to which the relevant activity is outsourced also increases. The (-) symbol, accordingly, indicates that as a consideration's magnitude level or degree increases, the level to which the relevant activity is outsourced decreases. The (±) symbol, finally, indicates that no particular directionality is hypothesized a priori, apart from the expectation of a significant relationship with the level of activity outsourcing. Afterwards, the same set of symbols is used to denote the actual relationship that emerges through the data analysis processes of the study.

Furthermore, by comparing the a priori hypothesized relationships with the ones observed, each of the study's original hypotheses is characterized within the table as: (1) 'Supported', if there is a significant relationship detected and the direction of the observed relationship is in agreement with the a priori hypothesized direction, (2) 'Contradicted', if there is a significant relationship but the direction of the observed relationship is opposite to the one expected, and finally (3) 'Not supported' if no significant relationship is found.

Each table, finally, concludes with an indication of the effect size of relationships found statistically significant. The measure used to proxy effect size, is the standardized coefficient of a consideration's variable at the hierarchical model where the variable was first entered in the regression equation and was found significant. In utilizing this measure, it is emphasized that the coefficients of different considerations are not directly comparable to each other as they relate to different regression models. Rather, what is of interest in these measures is their deviation from zero. Standardized coefficients closer to zero indicate smaller or negligible effect sizes while coefficients further away from zero (on either side) indicate larger or noteworthy effect sizes.

Control variable findings

Table 10-7 presents the summary of findings with regard to the study's control variables. As observed, the a priori hypothesized relationships for a firm's age and a firm's average ship age were not found to be significant. Thus, it is concluded that the aforementioned considerations play no part in the degree to which an activity is outsourced.

Table 10-7. Findings on the impact of control variables on activity outsourcing levels

Considerations and associated variable(s)	Hypothesized relationship	Relationship found	Hypothesis status	Effect size [1]
Firm Size				
Firm size - Total DWT (TRlog10)	(±)	(-)	Supported	-.190
Firm Age				
Firm Age (TRsqrt)	(±)	n/s	Not supported	
Firm Average Ship Age				
Average Ship Age (TRsqrt)	(±)	n/s	Not supported	

[1] Variable's standardized coefficient in the model of initial entrance (imputed dataset). Not comparable
[2] n/s: not significant relationship.

In contrast, the control hypothesis that a firm's size affects the level to which a maintenance activity is outsourced is supported by the empirical data. In particular, it is found that as a focal firm's size (as represented by the total DWT operated) increases, the activity outsourcing level decreases.

Efficiency-based considerations findings

Table 10-8 presents the summary of findings with regard to the perspective of efficiency considerations. As seen on the relevant summary findings table, an overwhelming number of hypotheses stemming from efficiency-based considerations are not supported. These include some component considerations of H_{TCE2} as well as the entirety of H_{TCE3}, H_{TCE4}, H_{TCE5}, H_{TCE6}, H_{TCE7}, H_{TCE8}, H_{TCE9} and H_{TCE10}. Furthermore, the component consideration of H_{TCE2} referring to principals' dedicated asset specificity is contradicted. Thus, the empirical data indicated that as a focal marine shipping firm's dedicated asset specificity with regard to an activity increases so does the activity's outsourcing level.

Table 10-8. Findings on the impact of efficiency considerations on activity outsourcing levels

Considerations and associated variable(s)	Hypothesized relationship	Relationship found	Hypothesis status	Effect size (1)
Behavioural Uncertainty	H_{TCE1} (-)			
Unreliability of suppliers	(-)	(-)	Supported	-.194
Principal's Asset Specificity	H_{TCE2} (-)			
Principal's human asset specificity (TRsqrt)	(-)	(-)	Supported	-.157
Principal's physical asset specificity (TRsqrt)	(-)	n/s	Not supported	
Principal's dedicated asset specificity (TRsqrt)	(-)	(+)	Contradicted	.294
Principal's procedural asset specificity (TRsqrt)	(-)	n/s	Not supported	
Principal's temporal specificity (TRsqrtRflct)	(+)	n/s	Not supported	
Principal's Proprietary Asset Exposure	H_{TCE3} (-)			
Principal's brand capital exposure (TRsqrtRflct)	(+)	n/s	Not supported	
Principal's proprietary info exposed (TRsqrt)	(-)	n/s	Not supported	
Agent's Asset Specificity	H_{TCE4} (+)			
Agent's human asset specificity	(+)	n/s	Not supported	
Agent's physical asset specificity	(+)	n/s	Not supported	
Agent's dedicated asset specificity	(+)	n/s	Not supported	
Agent's procedural asset specificity	(+)	n/s	Not supported	
Agent's temporal asset specificity	(+)	n/s	Not supported	
Agent's Proprietary Assest Exposure	H_{TCE5} (+)			
Agent's brand name capital exposure	(+)	n/s	Not supported	
Agent's proprietary info exposed (TRsqrt)	(+)	n/s	Not supported	
Volume Uncertainty	H_{TCE6} (-)			
Difficulty to predict demand volume	(-)	n/s	Not supported	
Technological Uncertainty	H_{TCE7} (-)			
Speed x unpredictability of tech. devel. (TRsqrt)	(-)	n/s	Not supported	
Value Assessment Ability	H_{TCE8} (+)			
Ease of pricing tasks in the activity	(+)	n/s	Not supported	
Contribution Assessment Ability	H_{TCE9} (+)			
Ease of supplier performance evaluation	(+)	n/s	Not supported	
Transaction Frequency	H_{TCE10} (-)			
Frequency of utilizing the transaction	(-)	n/s	Not supported	

(1) Variable's standardized coefficient in the model of initial entrance (imputed dataset). Not comparable
(2) n/s: not significant relationship.

Finally, two considerations' hypothesized relationships are fully supported by the study's empirical data analysis. These include the principals' human asset specificity component consideration of H_{TCE2} as well as H_{TCE1} referring to the behavioural uncertainty observed by principals on behalf of agents. Thus, it is found that the higher a principal's human asset specificity is in a particular maintenance activity, the less outsourced that activity is. Similarly, the higher a principal's perception of behavioural uncertainty with regard to agents is in a particular activity, the less outsourced that activity is.

Dependency-based considerations findings

Table 10-9 offers the summary of findings with regard to the study's dependency-based considerations. As witnessed in the relevant table, only one of the hypotheses formulated within this strategic perspective is exclusively not supported by significant findings. This refers to H_{RDT2} with regard to principals' activity internalization difficulty. In contrast, the empirical data provided significant findings for the rest of the perspective's hypotheses.

In the case of H_{RDT1} referring to principals' dependence on agents (from a business environment structure point of view) it is found that the higher that dependence in a particular activity, the more outsourced the activity is. As such, the originally hypothesized relationship is contradicted. Nevertheless, the particular operationalization of power imbalance is merely proxied and lacks the agent's environmental structure dependence counterpart (due to missing value concerns covered in the previous chapter). An analogue to the aforementioned missing counterpart is provided by the agents' actual dependence on principals consideration of H_{RDT4}.

Table 10-9. Findings on the impact of dependency considerations on activity outsourcing levels

Considerations and associated variable(s)	Hypothesized relationship	Relationship found	Hypothesis status	Effect size (1)
Power Imbalance (proxy)	H_{RDT1}(+)			
Principal's dependence on agents (TRlog10)	(-)	(+)	Contradicted	.268
Unilateral Power Restructuring Operations	H_{RDT2}(+)			
Resource internal. potential (difficulty) (TRsqrt)	(-)	n/s	Not supported	
Bilateral Power Restructuring Operations	H_{RDT3}(+)			
Cooptation potential	(+)	(+)	Supported	.200
Agent Actual Dependence	H_{RDT4}(+)			
Principal's input to agent business (TRsqrt)	(+)	(+)	Supported	.127

(1) Variable's standardized coefficient in the model of initial entrance (imputed dataset). Not comparable
(2) n/s: not significant relationship.

H_{RDT4} is supported by the study's empirical analyses. In other words it is found that the higher the agents' actual dependence on a focal principal is in a particular activity, the more outsourced that activity is. Finally, support is further granted to H_{RDT3} with regard to principals' cooptation potential. As such, it is found that the higher a principal's cooptation potential towards agents in a particular activity is, the more outsourced that activity is.

Competence-based considerations findings

Table 10-10 presents the summary of findings with regard to the study's competence-based considerations. As witnessed, none of the hypotheses formulated within the strategic perspective is supported by significant and concurring findings. Hypotheses not supported by significant findings include H_{RBV1}, H_{RBV2}, H_{RBV4} and H_{RBV5}.

Table 10-10. Findings on the impact of competence considerations on activity outsourcing levels

Considerations and associated variable(s)	Hypothesized relationship	Relationship found	Hypothesis status	Effect size [(1)]
Resource Value I	H_{RBV1} (-)			
Contribution to higher gains	(-)	n/s	Not supported	
Resource Value II	H_{RBV2} (-)			
Contribution to lower costs	(-)	n/s	Not supported	
Potential Resource Value	H_{RBV3} (-)			
Potential contribution to gains or costs	(-)	(+)	Contradicted	.120
Natural Resource Scarcity	H_{RBV4} (-)			
Difficulty of recruitment	(-)	n/s	Not supported	
Resource Inimitability	H_{RBV5} (-)			
Intrafirm causal ambiguity	(-)	n/s	Not supported	
Interfirm causal ambiguity	(-)	n/s	Not supported	
Resource social complexity (TRsqrt)	(-)	n/s	Not supported	

[(1)] Variable's standardized coefficient in the model of initial entrance (imputed dataset). Not comparable
[(2)] n/s: not significant relationship.

H_{RBV3}, on the other hand, is contradicted by the study's empirical data. As such, it is found that the higher an activity's potential future value (as perceived by principals) is, the more outsourced that activity is.

Identity-based considerations findings

Table 10-11 reports the summary of findings with regard to the study's identity-based considerations. As seen in the table, none of the hypotheses associated with the perspective seem to be supported by the empirical data. As such, it is indicated that the principals' organizational identity attributes have no say in the issue of the degree to which a maintenance activity is outsourced once the decision to outsource has been made.

Table 10-11. Findings on the impact of identity considerations on activity outsourcing levels

Considerations and associated variable(s)	Hypothesized relationship	Relationship found	Hypothesis status	Effect size [(1)]
Resouce-Identity Coherence	H_{OIC1} (-)			
Alignment of activity with identity	(-)	n/s	Not supported	
Institutional Forces Influence	H_{OIC2} (±)			
Institutional forces degree of infuence	(±)	n/s	Not supported	
Industrial Forces Influence	H_{OIC3} (±)			
Indutrial forces degree of infuence	(±)	n/s	Not supported	

[(1)] Variable's standardized coefficient in the model of initial entrance (imputed dataset). Not comparable
[(2)] n/s: not significant relationship.

Multiple linear regression model goodness of fit indicators

A final issue addressed in this summary of findings is the model fit of the parsimonious linear regression models developed within each perspective with the aim of explaining a maintenance activity's outsourcing levels. As mentioned earlier, the parsimonious model of each perspective is the one that includes all of the considerations found to be statistically significant during the relevant model-building processes. For reference purposes, model fit indicators of the most economical combined-perspective model are also reported. Table 10-12 presents the summary of the relevant findings.

Table 10-12. Multiple regr. model goodness of fit indicators of the strategic considerations

Best fitting model of	Variables included in model (df) (1)	Model F (2)	Variance explained (3)
Control variables	1	7.266	.036
Efficiency considerations	7	4.633	.148
Dependency considerations	4	9.063	.160
Competence considerations	2	5.105	.050
Identity considerations	-	-	-
Combined-perspective model	6	7.171	.186

(1) All individual consideration models include the significant control variable
(2) Ratio of mean square regression over mean square residual
(3) R^2 in the imputed dataset

10.3 Theoretical discussion of findings

Having concluded the summary report of the study's empirical findings, a discussion with regard to their interpretation is offered here. In adopting a critical realist philosophical standpoint, the interpretation and commentary of the study's findings is approached through a retroductive (sometimes also referred to as abductive) line of reasoning. Recognized as the key epistemological process of the critical realist school, retroduction is a "… mode of inference in which events are explained by postulating mechanisms which are capable of producing them…" (Sayer, 1992 p. 107). In this instance for example, the study is faced with a series of observed circumstances (from the domain of the empirical) where the initially hypothesized relationships (derived from previously postulated mechanisms of the domain of the real) are contradicted. Thus, the discussion is veered towards the critical review of the study's initial hypotheses and the postulation (and identification) of generative mechanisms through which the observed results may have been produced.

Before delving into the supposition of mechanisms capable of producing the study's findings, it is deemed prudent to reiterate and qualify the findings within the examined empirical context. In other words, it is deemed beneficial to state the study's empirical findings at the operationalized level in which the respondent marine shipping firms offered their input. This contextual recounting of the study's findings is offered both for the categorical firm boundary decision to outsource or not a maintenance activity as well as for the finer-grained issue of how much of an activity to outsource once the decision to outsource has been made. Afterwards, each finding is juxtaposed with the a priori hypothesized effects and a discussion surrounding their congruence or divergence and possible generative mechanisms is carried out. The contextual qualification of the findings is along with their juxtaposition with the original hypotheses is segmented according to the focal dependent outcome and the strategic perspective with which they are associated.

10.3.1 Discussion of findings on the decision to outsource

Contextualized qualification of findings

With regard to the decision of whether to outsource a maintenance activity or not, the study found that an activity is more likely to be outsourced by a marine shipping firm:

1. the more specialized the shipping firm's operating procedures need to be to procure the activity from specific suppliers

2. the more often the shipping firm gains valuable information about suppliers' operations
3. the more difficult it is for the shipping firm to predict its demand in the activity
4. the more uncertain technological developments surrounding the activity are
5. the more difficult it is for the shipping firm to fully develop the activity internally
6. the more valuable (in contribution to higher gains) the activity is considered
7. the more difficult it is for a shipping firm to recruit experienced professionals
8. the more ambiguous the activity's impact on the firm's bottom line performance is
9. the more shipping firm employees are assigned to the activity

Furthermore, it was found that a maintenance activity is less likely to be outsourced by a marine shipping firm:

10. the more important timing and on–time delivery is in the activity
11. the more capable a shipping firm is in determining a supplier's performance in the activity
12. the more frequently the activity is needed by the shipping firm

Juxtaposition of efficiency-based findings with expected effects
The empirical findings associated with efficiency-based considerations in the context of the categorical decision to outsource a maintenance activity or not, are no. 1, 2, 3, 4, 10, 11 and 12. Of these, no. 2, 10 and 12 are found to be in congruence with the a priori hypothesized effects while the rest are not.

The first empirical finding that contradicts the initially hypothesized relationship effect refers to a principal's procedural specificity. In this case, the issue refers to a marine shipping firm's need to employ specialized operating procedures in order to procure a maintenance activity from specific suppliers. The rationale behind transaction cost economics (which is the previously postulated mechanism of the domain of the real) in this case asserts that the more specialized such operating procedures need to be, the more 'held-up' the outsourcing firm will be in the relationship and more productive value will be jeopardized in the face of opportunistic suppliers. As such, the activity is expected to be less likely to be outsourced. Nevertheless, it is found more likely to be outsourced. Three lines of reasoning are offered to explain the contradiction.

The first relates to the notion of reciprocal exposure (De vita et al., 2010), or otherwise the reciprocal 'exchange of hostages' in a relationship (Williamson, 1983a). This aspect of transaction cost theory, while articulated since the early days of the theory's conception is often overlooked in relevant studies (note its absence from David and Han, 2004 as well as Geyskens et al., 2006). In a few words, this argumentation holds that if the suppliers offer something in exchange to the shipping firm's 'held-up' assets, then, they can signal a credible commitment to the relationship as hostages will be taken by either party. In following this line of reasoning, that certain something may be identified in the second empirical finding associated with efficiency considerations. As indicated, suppliers indeed seem to offer counterbalancing hostages in the form of valuable information with regard to their operations. What is particularly interesting here is that the counterbalance is detected in the study's novel put forth exposed value concerns that go beyond traditional notions of asset specificity. In accepting this line of reasoning, the overarching rationale of transaction cost economics is maintained intact and the contradictory finding is unsurprising.

A second line of reasoning with regard to the explanation of the same finding could refer to the relative monetary (or other) importance of the productive value 'held-up' in the relevant operating procedures when compared to other aspects or considerations of the decision to outsource. In other words, the aforementioned productive value may simply be too unimportant to deter shipping firms from pursuing an outsourcing strategy. In this case, the finding is attributed to conscious managerial choice and procedural specificity is no longer considered a generative mechanism of non-outsourcing but rather a consequence of outsourcing. Alas, the study has no way of ascertaining the validity of this claim.

The third line of reasoning that could provide an alternative explanation to the finding relates to the assertion that shipping firm decision makers simply do not take such nuanced cost efficiency considerations into account. That, however, does not mean to say that their relative monetary (or other) importance is necessarily negligible. If that is the case, then the argument falls back to the second line of reasoning. If, however, it is not and their importance is non-trivial then it is put forth that issues of organizational maladaptation (Hambrick, 1982) and/or organizational inertia (Hannan and Freeman, 1977; 1984) are at play. That is to say, that, while the particular and/or similar efficiency considerations are non-trivial in relation to current or future bottom-line firm performance (or even corporate survival odds), they are not taken into consideration due to managerial oversight or even inertia in the sense that such considerations are 'normally' not taken into account. In either case, the finding is attributed to unconscious managerial choice and procedural specificity is again rendered a consequence of outsourcing rather than an antecedent of non-outsourced states.

Similar lines of reasoning may be applied to the explanation of the rest of the empirical findings that contradict the initially hypothesized relationships. The third and fourth empirical findings, for example, state that the more uncertain a shipping firm is with regard to the demand volume and technological requirements of an activity the more likely that activity is to be outsourced. In other words, it is indicated that shipping firms prefer to outsource the management of volatility stemming from their projected demand in the activity as well as the technology required to perform it. In transaction cost economics, the rationale is that such uncertain requirements represent elements of risk in the formulation of necessarily incomplete contracts that are bound to increase transaction governance costs. In both cases, however, the argument can be made that in the study's empirical context the findings may either be the product of conscious or unconscious managerial choice. Again, that is that either the relevant transaction governance costs are consciously considered and found trivial, or that they are simply overlooked in a systematic way.

The final contradictory empirical finding with regard to efficiency-based considerations states that the more capable a shipping firm is in determining a supplier's performance in an activity the less likely that activity is to be outsourced. Transaction cost rationale, however, holds said contribution assessment ability as a safeguard mechanism against post-contractual non-compliance. In that sense, a requirement for this consideration to act as such a safeguard mechanism is the existence of a post-contractual phase. In other words, for the consideration to make sense, the decision to outsource must already be made so that a post-contractual phase exists. As such, it is only natural that firms that do not outsource an activity and perform it themselves are very much capable of evaluating a potential supplier's performance (as the finding indicates if causality is reversed). Consequently, the particular finding is essentially qualified as a non-issue since the consideration holds credence only in the context of outsourcing levels.

Juxtaposition of dependency-based findings with expected effects

The only empirical finding associated with dependency-based considerations in the context of the categorical decision to outsource a maintenance activity or not, is no. 5. The finding states that the more difficult it is for a shipping firm to fully develop an activity internally, the more likely that activity is to be outsourced. At face value, the finding could be considered self-evident. However, that would only be true if the norm in the shipping industry were that shipping firms do not handle engine maintenance activities and thus suffer from severe competence-deficiencies that disallow the internalization of said activities. That, however, is not the case (note the logarithmic transformation of the activity outsourcing level variable). Shipping firms would traditionally handle all but the most specialized of maintenance activities through competences developed in resident technical departments. As such, a non-outsourced initial state for the industry is assumed and the interpretation of the particular finding becomes more complex.

The rationale behind resource dependency theory (which in this case is the previously postulated mechanism of the domain of the real), holds the internalization potential of an activity to be a realistic unilateral power restructuring operation that can safeguard an outsourcing shipping firm against value expropriation in the presence of unfavourable power imbalance among the transacting partners. Otherwise phrased, the theory's argumentation is that if there is a chance that the suppliers may assume 'the upper hand' in an exchange relationship, the outsourced activity ought to be relatively easy to insource once again. Thus, the empirical finding can be held to contradict the theory's rationale, but only in the presence of non-trivial and unfavourable power imbalance. Two lines of reasoning are offered to explain the finding, both dealing with the presence of unfavourable power imbalance.

The first relates to the possibility that shipping firm decision makers view no foreseeable power imbalance in favour of suppliers and thus hold the associated value expropriation potential to be a non-issue. In this case, the finding is attributed to conscious managerial choice and resource internalization difficulty is no longer considered a generative mechanism of non-outsourcing (by virtue of the absence of unfavourable imbalance) but rather an ex-post consequence of outsourcing. Furthermore, the theory's rationale remains intact.

The second line of reasoning relates to the possibility that shipping firm decision makers are simply unaware or in err in underestimating the probabilities of present or future non-trivial and unfavourable power imbalances. As such, organizational maladaptation and inertia issues are brought to the forefront once again and the finding is attributed to unconscious managerial choice. In this case, resource internalization difficulty is similarly rendered a consequence of outsourcing rather than an antecedent of non-outsourced states (by virtue of the empirical finding). Regrettably, archival sources in the particular empirical context as well as the researcher's verbal correspondences with shipping firm executives seem to validate the latter line of reasoning rather than the former in many cases. Finally, the theory's rationale is contradicted in light of the presence of non-trivial unfavourable power imbalance (with the contradiction possibly explained by maladaptation).

Juxtaposition of competence-based findings with expected effects
The empirical findings associated with competence-based considerations in the context of the categorical decision to outsource a maintenance activity or not, are no. 6, 7, 8 and 9. All of the findings diverge from the a priori hypothesized effects.

The sixth empirical finding states that the more valuable an activity is considered in terms of contributions to higher gains for the shipping firm, the more likely that activity is to be outsourced. As such, the main premise of the resource-based view theory (in this case the previously postulated mechanism of the domain of the real) is contradicted as the theory's rationale asserts that valuable resources need to be shielded from imitation through hierarchical structures so that entrepreneurial rents may be appropriated. In simpler terms, the theory holds that the more valuable an activity is it should be the less likely that the activity is outsourced. In contradicting this basic premise of RBV (at least in the way that it is formulated in this study) two lines of reasoning may be offered to explain the finding.

The first relates to conscious managerial choice and postulates that shipping firm decision makers see added outweighing benefits in the decision to outsource (e.g. they foresee more value created through partnership arrangements). The second relates to unconscious managerial choice (i.e. judgment error). Support for the second line of reasoning is perhaps offered by the eighth finding that indicates that the more ambiguous the activity's impact on firm performance is the more likely the activity is to be outsourced. As such, managerial oversights may be attributed to the latter causal ambiguity and the way that it obstructs a traceable path for determining an activity's true value for a shipping firm.

In any case, in assuming an initial non-outsourced state for a shipping firm the rest of the findings' constructs may be considered consequences of outsourcing rather than antecedents of non-outsourcing. In assuming an outsourced initial state the findings may be interpreted at face value. For example, the seventh finding may be interpreted so that the difficulty of recruitment is an antecedent of outsourcing (at face value), or that the same difficulty is a consequence of outsourcing (assuming a non-outsourced initial state). Interestingly, the ninth and final finding for competence-based considerations indicates that the more employees are assigned to an activity, the more likely that activity is to be outsourced. The finding, which can only be seen as a consequence of outsourcing, indicates that outsourcing shipping firms dedicate more human resources to an activity when compared to their non-outsourcing peers. Finally, the same finding lends credence to transaction cost theory's postulation of increased governance costs (here in the form of human resources) in non-hierarchical governance structures due to increased needs for post-contractual compliance monitoring and enforcing requirements.

10.3.2 Discussion of findings on the level of activity outsourcing

Contextualized qualification of findings
With regard to the decision of how much to outsource a maintenance activity once the decision to outsource has been made, the study found that an activity is outsourced to a higher degree:

1. the more specialized the shipping firm's human resources need to be to procure the activity from specific suppliers
2. the more dependent the shipping firm is on suppliers from a general environmental structure perspective (i.e. the less suppliers there are able to offer the activity)

3. the more able the shipping firm is to influence the suppliers strategic decisions
4. the more dependent suppliers are on the shipping firm's contribution to operating revenues
5. the more likely the activity is to be valuable for the shipping firm in the future

Furthermore, it was found that a maintenance activity is outsourced to a lesser degree:

6. the larger the shipping firm is
7. the more unreliable suppliers are perceived to be by the shipping firm
8. the more specialized the shipping firm's know-how needs to be to procure the activity from specific suppliers

Juxtaposition of efficiency-based findings with expected effects
The empirical findings associated with efficiency-based considerations in the context of the level of activity outsourcing, are no. 1, 7, and 8. Of these, no. 7 and 8 are found to be in congruence with the a priori hypothesized effects while no. 1 is not.

With regard to efficiency considerations, the findings indicate, in general, that behavioural uncertainty and the principal's asset specificity play a role in determining the level to which an activity is outsourced. Principally, the seventh finding that deals with the core construct of behavioural uncertainty (rendered in this study as a variable consideration rather than an assumption as in transaction cost theory's original formulation) indicates that the more reliable (in terms of post-contractual predictability) suppliers are perceived to be, the more outsourced a maintenance activity is. Furthermore, in the eighth finding it is indicated that the less specialized a shipping firm's know-how needs to be to procure an activity from specific suppliers, the more outsourced the activity is. The former finding is interpreted as an overarching condition for the increased outsourcing of an activity while the latter is thought of as a safeguard against relationship lock-in.

The only contradictory empirical finding, the first one, refers to a marine shipping firm's need to employ specialized human resources in order to procure a maintenance activity from specific suppliers. In this case, specialization refers to the dedication of a specific volume of resources (here, employees) that would need to change if other suppliers are elected. As such, the finding asserts that the more volume change is needed to procure an activity from other suppliers, the more outsourced an activity is. This contradicts transaction cost rationale however, as increased volume change represents the increased exposure of productive value. Similar to the case of procedural asset specificity in the decision to outsource or not, the finding may either be explained by conscious managerial choice, whereby the productive value involved is legitimately considered negligible, or by unconscious managerial choice, whereby said productive value is improperly ignored. In the latter case, maladaptation and inertia related issues raised previously are similarly held to apply.

Juxtaposition of dependency-based findings with expected effects
The empirical findings associated with dependency-based considerations in the context of the level of activity outsourcing, are no. 2, 3, and 4. Of these, no. 3 and 4 are found to be in congruence with the a priori hypothesized effects while no. 2 is not.

What is noted in the case of dependency considerations is that the core tenets of resource dependency theory (the previously postulated mechanism of the domain of the real) are, generally, validated. While the second finding hints at the presence of unfavourable power imbalance for shipping firms, it does so only limitedly, as the agents' general dependence counterpart is absent. Furthermore, the supported hypotheses in findings three and four indicate that shipping firms are capable of leveraging cooptation and direct dependence tactics in order to counteract any power unbalancing factors.

Juxtaposition of competence-based findings with expected effects
The only empirical finding associated with competence-based considerations in the context of the level of activity outsourcing, is no. 5. The finding states that the more likely an activity is to be valuable for a shipping firm in the future, the more outsourced that activity is. The finding contradicts the rationale of resource-based view theory much in the same way that finding six did in the categorical decision to outsource or not. As such, the same lines of reasoning employed to explain the latter finding are similarly used for the present one as well. Thus, the finding may be attributed to either conscious or unconscious managerial choice with all of the associated repercussions.

10.3.3 Answering the study's research questions

In identifying a research gap in the servitization academic discourse with regard to the considerations that influence a potential customer firm's propensity to accept or reject servitized offerings, the study posed the research question of which strategic considerations influence a customer firm's decision to outsource or not activities targeted by transactionally servitized offerings. In further operationalizing the general research question, the study sought the aforementioned considerations within the strategic perspectives of efficiency, dependency, competence and identity. Upon articulating each strategic perspective through a particular theoretical framework specific considerations were drawn from the transaction cost economics, the resource dependency theory, a strand of the resource-based view of the firm and the organizational identity academic discourses. Upon formulating the considerations into specific hypotheses and exploring their validity through variance-based empirical analysis methods and a retroductive inference approach, the study found that:

The likelihood that a maintenance activity is outsourced to suppliers is influenced by:

- The customer's temporal specificity efficiency-based consideration, so that the higher temporal specificity in the activity is, the less likely the activity is to be outsourced
- The suppliers' proprietary information exposure efficiency-based consideration, so that the higher said exposure in the activity is, the more likely the activity is to be outsourced
- The customer's transaction frequency efficiency-based consideration, so that the higher the frequency of activity use is, the less likely the activity is to be outsourced
- The customer's volume uncertainty efficiency-based consideration, so that the higher volume uncertainty is, the more likely the activity is to be outsourced
- The customer's technological uncertainty efficiency-based consideration, so that the higher technological uncertainty is, the more likely the activity is to be outsourced

- The customer's intrafirm causal ambiguity competence-based consideration, so that the higher said causal ambiguity is, the more likely the activity is to be outsourced

The level to which a maintenance activity is outsourced to suppliers is influenced by:

- The size of the customer firm, so that the larger the size the less outsourced the activity is
- The suppliers' behavioural uncertainty efficiency-based consideration, so that the higher behavioural uncertainty is the less outsourced the activity is
- The customer's human asset specificity efficiency-based consideration, so that the higher said specificity is the less outsourced the activity is
- The customer's cooptation potential dependency-based consideration, so that the higher the cooptation potential the more outsourced the activity is
- The suppliers' actual dependence dependency-based consideration, so that the higher said dependence is the more outsourced the activity is

10.4 Theoretical implications of the study

This section addresses the theoretical implications derived from this study of the servitization phenomenon through the potential customers' strategic point of view. In engaging both the servitization as well as the firm boundary/outsourcing literatures, the study's contributions are directed to each academic discourse respectively.

10.4.1 Implications to the servitization discourse

The study contributes to the servitization academic discourse in a number of ways. Table 10-13 offers a succinct presentation of the study's key implications towards this literature stream.

Table 10-13. Study's implications towards the servitization academic discourse

Addressed space	Principle points
Ontology of servitization	• Servitization is a competitive differentiation strategy involving traditional and novel tactics • Servitization is not necessarily an imperative to which all manufacturers should aspire to
Typology of servitization	• There are more than one ways for a manufacturer to servitize • At least two conceptually distinct servitization avenues are identified: Transformational and Transactional Servitization
Studying transactional servitization	• Studies would benefit by considering the strategic motivations of customers in addition to the well documented motivations of aspiring suppliers in a given servitization context
Enablers of transactional servitization	• Transactional servitization initiatives are found to be favoured when focused on activities with: - low temporal specificity on behalf of customers - low transaction frequency on behalf of customers - low switching costs (in terms of required know-how) on behalf of customers - high volume uncertainty on behalf of customers - high technological uncertainty on behalf of customers
Barriers to transactional *servitization*	• Transactional servitization initiatives are found to be hindered when aspiring suppliers: - do not signal 'credible commtiments' to the relationship with customers - do not allow customers a certain level of influence over their strategic decisions - do not enjoy a reputation of reliability and good brand name capital
Structure of servitization literature	• The existing body of knowledge would profit from more rigorous theorizing, model building and confirmatory approaches that promote the research agenda beyond the descriptive state

The first contribution to the servitization discourse relates to the study's acknowledgment that servitization is a competitive differentiation strategy that may include traditional competitive tactics (such as product differentiation and market diversification) as well as novel ones (such as transaction structure and governance modification). Apart from the obvious implications of this contribution towards the ontology of servitization it is further put forth that when the phenomenon is viewed from an elevated strategic perspective, it is found to be just one of a number of strategies by which a mature manufacturer may strive for competitive advantage. Corollary to this acknowledgement is that there is no obvious reason to assume that a transition to services (i.e. servitization) is a 'one-size-fits-all' solution to a manufacturer's economic woes. As there is no equifinality in business strategy (i.e. there is no ultimate all-purpose strategy to overcome competition in all cases), it should be evident that services are not a panacean solution. As such, studies focusing on the difficulties of implementing a servitization strategy would benefit by exploring whether the strategy makes sense in a given context before delving into operational intricacies.

The second major contribution relates to the acknowledgment that there are more than one ways by which a manufacturer may servitize. The study's nuanced approach to the servitization phenomenon revealed that there are at least two conceptually distinct avenues towards servitization (i.e. Transformational and Transactional Servitization). Each approach is found to exhibit particular and distinguishing characteristics, depending on the object of servitization in each case. Indeed, it is pointed out that Rolls Royce's transactional servitization of the core offering (i.e. the offering of airplane engines through varied usage regimes) is very much different than IBM's transformational servitization of the entire firm into a versatile IT consultancy. Corollary to this acknowledgment, is that Product-Service continuums that illustrate some prototypical roadmap to servitization (e.g. Oliva & Kallenberg, 2003) need to be treated very carefully as they indirectly imply the existence of a singular approach. Furthermore, in offering both a conceptual as well as paradigmatic analysis of each approach, the study enables future research to specifically identify the type of servitization involved and thus enhance the literature's preciseness with regard to 'what' is actually studied.

The third major contribution to the servitization discourse relates to the standpoint through which the phenomenon is explored. Previous research has predominantly been occupied with the supplying manufacturer's side while focusing on the change process and organizational obstacles of bringing a servitization effort to fruition. This approach, however, while still informative and useful, implies that the attempted servitization initiative is: (a) expected and welcomed by customers and (b) that it is an appropriate strategy for the enacting firm at that particular point in time. The present study takes a step back and questions the customer demand assumption by approaching servitization from the customer's perspective while further examining it from a strategic viewpoint. In so doing, the study reveals that in contexts where servitization is largely unsolicited, customers do not necessarily buy in to concepts of value co-creation and mutual benefit (e.g. Baines et al., 2009a) but rather view such initiatives as a 'tug-of-war' between upstream and downstream economic entities (i.e. suppliers and customers) that compete over the appropriation of more value within a non-expanding value chain.

Furthermore, the study finds that a variety of strategic motivations affect a customer's propensity to accept or reject transactionally servitized offerings. Among the enablers of transactional servitization, the study finds that such initiatives are favoured when they focus on activities where the customer exhibits low temporal specificity (i.e. timing and coordination is not very important), low transaction frequency (i.e. the activity is not needed frequently), low switching costs in terms of required know-how (i.e. the customer does not require specialized knowledge to switch suppliers), high volume uncertainty (i.e. the customer's demand for the activity is largely unpredictable) and high technological uncertainty (i.e. the customer is relatively unsure with regard to the future technological requirements of the activity). Among the barriers of transactional servitization, the study finds that such initiatives are hindered when the aspiring supplier does not signal 'credible commitments' to the relationship (i.e. the supplier does not expose valuable assets to the customer when the customer does), does not allow a certain level of influence over strategic decisions (that could potentially affect the customer) and when the supplier does not enjoy a reputation for reliability and fair exchange practices.

Finally, on a note concerning the structure of the servitization literature, it is proposed that the existing body of knowledge would benefit from more rigorous theorizing, model building and confirmatory approaches that promote the servitization research agenda beyond descriptive explorations of the phenomenon and into more formalized territory. Adjacent literature streams from the fields of strategy, organizational change and marketing that have long dealt with issues upon which servitization touches could potentially be fruitful sources of insight, inspiration and future proposition-building.

10.4.2 Implications to the firm boundary/outsourcing discourse

The study's implications with regard to the firm boundary/outsourcing academic discourse are offered separately for each strategic perspective included in the study. Table 10-14 offers a succinct presentation of the study's key implications towards the relevant literature streams.

Table 10-14. Study's implications towards the firm boundary/outsourcing academic discourse

Addressed space	Principle points
Studying firm boundary decisions	• There are two tiers in any firm boundary decision: (a) Whether or not to outsource an activity at all, and (b) How much of the activity to outsource if the decision to outsource is made
Transaction Cost Theory	• Expectations of opportunism may meaningfully be considered as a variable condition instead of a constant assumption through behavioural uncertainty as ex-post agent unpredictability • Behavioural uncertainty as ex-post agent unpredictability is an insightful consideration explaining how much of an activity is outsourced • Certain types of a principal's asset specificity may be valued over others in a given context: E.g. In the study's context temporal and human asset specificity may be valued above procedural and dedicated asset specificity while other types were deemed insignificant • Proprietary asset exposure (in the form of privileged information exposed) may meaningfully be considered as value exposed in a relationship beyond asset specificity • Reciprocal asset exposure matters in the decision to outsource an activity or not • Transaction frequency plays a role in the decision to outsource an activity or not
Resource Dependency Theory	• A principal's cooptation potential affects how much of an activity is outsourced • An agent's actual dependence affects how much of an activity is outsourced
Resource-Based View theory	• Core RBV arguments may be articulated into a cohesive and testable framework aimed at explaining firm-boundary decisions • Intrafirm causal ambiguity is a double-edged sword that while shielding resources from imitation may unknowingly lead firms to outsource valuable resources • Non-bounded rationality should not be assumed, but allowed to vary and be controlled for before attempting to confirm any of RBV's core tenets
Identity perspective	• While not significant in the study's context, the core argument may hold in other contexts

On the study of firm boundary decisions

A basic implication emerging from this study of firm boundary decisions in the context of transactional servitization is that there are two tiers in any firm boundary decision. In other words, principals considering the outsourcing of a given activity are faced with two key questions: (a) whether or not to outsource an activity at all, and (b) how much of the activity to outsource once the decision to outsource is made. This acknowledgment reflects on past research in firm-boundary decisions that has largely treated outsourcing as a binary outcome (i.e. considering only the first tier question). The present study attempts to alleviate this deficiency by utilizing two distinct statistical analysis techniques (i.e. logistic and linear regression) in order to answer each of the principals' questions. While other methodologies may be employed to the same effect, it is suggested that future research should strive to account for both tiers so that a nuanced view of outsourcing emerges.

Implications to the efficiency perspective

Efficiency-based considerations were articulated within the study through the tenets of an extended view of the transaction cost economics (TCE) discourse (e.g. Williamson, 1983;1985;1988), that went beyond the traditional Williamsonean strand to further include insights from both the information costs (Alchian and Demsetz, 1972) as well the information asymmetry (Akerlof, 1970) perspectives (Carter and Hodgson, 2006). Asset specificity definitions were informed by Williamson (1988), Zaheer and Venkatraman (1995), Geyskens et al. (2006) and De Vita et al. (2010) among others while technological uncertainty and volume uncertainty were defined as per Walker and Weber (1984). With regard to behavioural uncertainty, however, the study departed from received notions that regarded it solely as a performance evaluation issue (e.g. Geyskens et al., 2006) and put it forth to represent ex-post behavioural unpredictability, thus addressing Moran and Ghosal's (1996) behavioural assumption criticisms. The performance evaluation issue then, informed by Jacobides and Hitt (2005), was delineated into the separate considerations of value assessment ability and contribution assessment ability. Transaction frequency, a construct always present in formulations of TCE but seldom tested in empirical studies (Geyskens et al. 2006) was also included in the study. Afterwards, inspired by the work of Teece (1986), Pisano (1990) and Mayer and Salomon (2006) on the appropriability issue, the study complemented TCE's notion of exposed assets in a transaction with the novel construct of proprietary asset exposure. Finally, the relevant framework took into account the often overlooked issue of reciprocal exposure by extending the framework's contents so as to also account for the agents' asset specificity and proprietary asset exposure in an exchange (Williamson, 1983a; Buvik and Reve, 2001; De vita et al. 2010).

The study's main implications towards Transaction Cost theory revolve around six principle points. The first two points relate to the study's definition of behavioural uncertainty as ex-post agent unpredictability and its promotion to the status of a core attribute allowing for varying degrees of opportunism. The study suggested that expectations of opportunism may meaningfully be considered as a variable condition without compromising TCE's core rationale. Thus, instead of assuming a constant level of opportunism throughout, what is assumed is merely the existence of opportunism with its levels permitted to vary freely. Upon concluding its empirical investigations, the study found that the aforementioned novelty allowed behavioural uncertainty to emerge as a consideration explaining how much of an activity is outsourced.

The third point indicating the study's implications to Transaction Cost Theory relates to the varied importance of different types of asset specificity according to contextual factors. For example, the study's analysis of the elected empirical context found that temporal specificity may be valued over procedural asset specificity with regard to the decision of whether or not to outsource an activity. Similarly, the study found that human asset specificity is perhaps deemed more important than dedicated asset specificity in the decision of how much of an activity to outsource. Simultaneously, all other types of asset specificity were found insignificant towards either decision tier. Consequently, it is suggested that future studies examining asset specificity in a particular context first explore which types are more relevant than others before proceeding to statistical analyses. That way, more nuanced and insightful examinations could emerge without the unnecessary sacrifice of valuable research capital.

The fourth point relates to the study's inclusion of the novel construct of proprietary asset exposure within the Transaction Cost framework. The study suggested that proprietary assets (such as privileged information and intellectual property) could meaningfully be considered as value exposed in a relationship beyond asset specificity concerns. The assertion was found to be in congruence with the framework's overall rationale while the study's empirical analyses revealed that proprietary asset exposure (in the form of privileged information exposed) is significant to the decision of whether or not to outsource an activity. As such, it is proposed that future TCE studies pay closer attention to this consideration.

The fifth point relates to the issue of reciprocal exposure in an exchange. Though intended to be part of the framework since the theory's early days (e.g. Williamson, 1983) the issue has been largely overlooked in the literature (note its absence in reviews such as David & Han, 2004; Geyskens et al., 2006) bar few exceptions. The study took reciprocal exposure into account and found it to be significant in the decision of whether to outsource an activity or not. Thus, it is suggested that future studies refrain from excluding this aspect of Transaction Cost theory.

In a similar fashion, the final point with which the study contributes to Transaction Cost theory revolves around the near systematic oversight of yet another exchange attribute from the literature, that of transaction frequency. The study's empirical analyses uncovered evidence that the particular attribute does indeed play a role in the decision to outsource an activity or not in a way predicted by TCE propositions. As such, it is suggested that its omission from similar future studies would constitute an unfortunate oversight.

Implications to the dependency perspective

Dependency-based considerations were articulated within the study through resource dependency theory propositions put forth primarily by Casciaro and Piskorsky (2005), Jacobs (1974) and Lawler and Yoon (1996). The study's contributions to the perspective are centred on the empirical investigation of the relevant framework augmented by the consideration of unilateral and bilateral power restructuring operations (namely, resource internalization and cooptation) as well as the novel consideration of agent actual dependence as factors alleviating power imbalance concerns. The study found evidence that both the considerations of a principal's cooptation potential as well as an agent's actual dependence have meaningful roles to play in the explanation of firm-boundary decisions as counteracting elements of potentially unfavourable power imbalances in supplier-customer relations. In particular, the aforementioned considerations are found to affect a principal's decision with regard to how much of an activity to outsource once the decision to outsource has been made. As such, it is suggested that future studies incorporating dependency considerations take them into account.

Implications to the competence perspective

Competence-based considerations were articulated within the study through the resource-based view (RBV) theory propositions principally put forth by Peteraf and Barney (2003) and supported by qualifying inputs from Barney (1991), Helfat and Peteraf (2003) as well as Santos and Eisenhardt (2005) among others. Causal ambiguity, for example, was delineated through the work of King (2007). The study's principle contribution to the perspective is centred on the formulation of a cohesive and testable RBV-based framework for the explanation of firm-boundary decisions. Taking note of earlier attempts (e.g. McIvor, 2009) at such an endeavour, the study strived to construct a stand-alone alternative formulation based on the rich background of RBV research as well as a number of novel assertions. Notably, the concept of resource value was complemented with the novel concept of potential resource value in an attempt to account for a resource's potential future value contributions.

Nevertheless, the study's empirical analyses indicated a number of surprising results as most of the framework's rational propositions were contradicted (e.g. the more a resource was deemed to contribute to the firm's competitive advantage the more likely it was to be outsourced). At the same time, however, evidence emerged to support the notion that intrafirm causal ambiguity perhaps plays a more important role than initially thought. While initially considered solely as an attribute augmenting the shielding of potentially valuable resources from imitation, in retrospect, it is clear that this assertion was based on the assumption that firms would retain resources with questionable bottom-line performance effects in-house. In other words, there was an implicit assumption holding that 'if a firm is unsure of how a resource affects bottom-line performance, it will keep it in-house, just in case'. The empirical evidence, however, indicates that the opposite is true so that firms shed resources whose effect is ambiguous. As such, it is emphasized that intrafirm causal ambiguity is a double-edged sword that, while indeed shielding resources form imitation, may additionally confound a focal firm's ability to discern a resource's value to the point where valuable resources are unknowingly outsourced.

Theoretically speaking, the aforementioned observations simply point back to the RBV-based framework's at least partial assumption of non-bounded rationality acknowledged in section 5.5.1 (see page 76). As such, the implication for theory and future RBV studies is that the assumption of non-bounded rationality is perhaps an untenable ideal that should be allowed to vary (e.g. as a separate consideration, or in conjunction with intrafirm causal ambiguity) and be controlled for before attempting to confirm any of RBV's other core tenets. In practice, it is suggested that firms pay closer attention to, and carefully analyse, the roots of their bottom-line successes and failures so as to be in a better position to assess the value of the resources they control.

Implications to the identity perspective

Identity-based considerations were articulated within the study through propositions mainly put forth by Santos and Eisenhardt (2005), based on the work of Weick (1995) and Kogut (2000) on sensemaking and organizational identity respectively. The study's contribution to the perspective revolves around the empirical investigation of its core firm-boundary discriminating argument of resource-identity coherence put forth by Santos and Eisenhardt (2005). Though not significant in the study's empirical context, indications that support the argument's discriminating merits were uncovered (e.g. the directionality of influence was always found as initially proposed). Given that the study is limited in the examination of a single empirical context (i.e. the relatively confined industry segment of deep-sea marine shipping), it is simply suggested that the perspective's core argument be included in future studies conducted in other contexts so that a cumulative body of evidence that allows further judgment emerges.

10.5 Practical implications: on the success of servitization initiatives

Upon uncovering a series of strategic considerations held to influence a customer firm's propensity to accept servitized offerings in the guise of performance-based contracts for long-life capital equipment, the study offers a number of suggestions for relevant practitioners and manufacturing firms aspiring to promote offerings of this type.

Primarily, it is suggested that performance-based contracts should target activities that do not exhibit increased sensitivity to timing and on-time delivery specifications. At the same time it is further suggested that the targeted activities are not of relatively frequent use to the customer firm.

Additionally, it is suggested that aspiring suppliers should be ready to assume full responsibility for the management of the customer firm's demand volume in the targeted activities while further handling any re-specifications deriving from technological developments in tools, methods or equipment necessary to carry out the activities. On a similar note, it should be emphasized that the less specialized the customer firm's know-how needs to be to take advantage of the benefits of performance-based contracts offered, the more likely those contracts are to be accepted.

Furthermore, it is suggested that aspiring suppliers of performance-based contracts should offer credible commitments to potential customer firms that signal the existence of reciprocity in the exchange relationship. Frequent flow of information from the supplier to the customer could go a long way in achieving this goal. Additionally, reciprocity may further be signalled by allowing the customer to provide input to decision-making processes that could potentially affect them.

Finally, it should be underlined that an aspiring supplier firm's past contractual performance and reliability is a factor expected to be weighed-in seriously by potential customer firms deliberating the acceptance of a servitized offering. Thus, good brand name capital in the sector could mean the difference between success and failure.

10.6 Research limitations

A number of limitations narrow the scope and generalizability of the study's findings. These refer to the particular phenomenon studied, the phenomenon actually observed, the theoretical models utilized to explore the study's research questions, the methodology employed to conduct empirical research as well as the empirical setting and time from which observations were drawn.

With regard to the phenomenon studied, namely the servitization of manufacturing, the study is limited to the investigation of a particular manifestation of this emerging phenomenon, namely performance-based contracts for long-life capital equipment. As such, any conclusions drawn relate mainly with transactional servitization associated with capital goods rather than with other forms of servitization.

Furthermore, a potential customer firm's propensity to accept transactionally servitized offerings is approximated through the customer firm's propensity to outsource activities most commonly targeted by such offerings. Dependent on the operational breadth and depth of a particular servitized offering and the capital good involved, other activities may need to be considered as well.

Additionally, the study is limited to the consideration of four strategic perspectives employed to explore a customer firm's propensity to outsource activities, namely, efficiency, dependency, competence and identity. Furthermore, each strategic perspective was articulated through a particular theoretical framework (in this case involving transaction cost economics, resource dependency theory, a strand of the resource-based view of the firm as well as specific organizational identity considerations). Other strategic perspectives and alternative theoretical frameworks such as real options theory, the knowledge-based view of the firm and social exchange theory could inform further investigations of the phenomenon and provide complementary insights.

With regard to the methodology employed to conduct empirical research, the study is limited by being structured around a quasi-experimental cross-sectional survey research design. While a longitudinal approach is acknowledged to have many benefits to offer, it is excluded due to practical considerations. Similarly, it is also recognized that the study could profit from the benefits of formal case study approaches. Their absence is offset by the consideration of extensive archival information in conjunction with verbal correspondences and informal meetings with a significant number of the survey's informants.

Finally, the study is limited in the empirical examination of a single, though global, industrial sector at a particular moment in time while further focusing on the servitization of a particular technological artefact. Specifically, the study draws its empirical insights from information collected from a sample of deep-sea marine shipping firms in the third and fourth quarters of 2011 with regard to the shipping firms' ship main propulsion engines.

10.7 Recommendations for further studies

A number of alternative research initiatives may utilize the present study as a pivot point to further explore both the servitization of manufacturing phenomenon as well as the explication of firm-boundary decisions.

With regard to the servitization of manufacturing, two major further study initiatives are identified. The first relates to the phenomenon's approach as a set of alternative competitive differentiation strategies enacted by manufacturers, while the second relates to the further examination of antecedents affecting a servitized offering's acceptance by potential customer firms. In the first case, it is suggested that future studies focus on the further conceptual as well as practical delineation of alternative servitization strategies. With a plethora of servitization initiatives and variants thereof enacted in a variety of industrial contexts, it is held that the relevant academic discourse would benefit from typological research projects striving to map just how many servitization alternatives there are ‘out there’ and explore how they relate to or contrast each other. In the second case, it is suggested that further studies explore the customer’s perspective in more detail so as to verify the study’s findings and uncover further insights into the factors that motivate or demotivate customer firms to accept servitized offerings.

With regard to the explication of firm-boundary decisions, it is suggested that future studies further develop combined-perspective or otherwise multi-theoretic approaches while simultaneously expanding the theoretical grounds from which insights are drawn. Furthermore, it is put forth that the relevant academic discourse would profit from finer grained research approaches that explore differences between substitution and abstention-based sourcing decisions as well as approaches that distinguish the outsourcing of a given activity’s performance from the outsourcing of responsibility for the activity (i.e. the ownership of liabilities incurred in the case of poor or insufficient activity performance).

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Appendix A

A.1 Membership list of INTERCARGO
A.2 Membership list of INTERTANKO
A.3 Layout of survey data collection instrument (PDF version)
A.4 Sample cover letter delivered during the survey's administration

A.1 Membership list of INTERCARGO

Table A.1 Membership list of INTERCARGO (as of August, 2011)

No.	Marine shipping firm name	Location	Corporate website	Ships	Approx. DWT
1	Adelfia Shipping Enterprises	Greece	-	5	325,413
2	Aegean Bulk Co Ltd	Greece	www.aegeanbulk.gr	9	647,395
3	Alnav Naftiliaki SA	Greece	-	1	73,910
4	Allseas Marine SA	Greece	www.allseas.gr	17	1,104,413
5	Anangel Maritime Services Inc	Greece	www.anangel.gr	33	5,859,242
6	Andriaki Shipping Co Ltd	Greece	www.andriaki.gr	16	1,973,302
7	Aug. Bolten	Germany	www.aug-bolten.de	16	475,271
8	Belships	Norway	www.belships.com	3	174,054
9	Bibby Line Ltd	United Kingdom	www.bibbyline.co.uk	2	59,286
10	Compagnie Maritime Belge - Bocimar	Belgium	www.cmb.be	50	5,287,722
11	Giuseppe Bottiglieri di Navigazione SpA	Italy	www.gbottiglieri.com	13	1,080,660
12	Brave Maritime Corp Inc	Greece	www.vafiasgroup.gr	56	2,137,598
13	Carras (Hellas) SA	Greece	-	10	1,426,361
14	Cetragpa SNC	France	www.lda.fr	33	1,976,000
15	Chandris (Hellas) Ltd	Greece	-	24	3,749,562
16	C.P. Lemos Shipping SA	Greece	-	2	147,515
17	Chartworld Shipping Corp	Greece	www.chartworld.gr	44	1,637,749
18	Clipper bulk	Denmark	www.clipper-bulk.com	160	4,083,942
19	COSCO (HK) Shipping Co Limited	Hong Kong SAR	www.coscochs.com.hk	100	5,000,000
20	COSCO Bulk Carrier Co., Ltd.	P.R. China	www.cosbulk.com	80	6,000,000
21	Dalex Shipping Co SA	Greece	www.dalex.gr	1	40,908
22	Derna Carriers SA	Greece	www.derna-carriers.gr	3	53,041
23	Diana Shipping Services SA	Greece	www.dianashippinginc.com	35	3,388,962
24	Eagle Shipping International (USA) LLC	USA	www.eagleships.com	39	2,100,418
25	Eastern Mediterranean Maritime Limited	Greece	www.eastmed.gr	31	3,128,702
26	Emarat Maritime	United Arab Emir.	www.emaratmaritime.com	12	885,036
27	Empros Lines Shipping Co	Greece	www.emproslines.com	2	106,188
28	Entrust Maritime Co Ltd	Greece	www.entrust.gr	4	238,426
29	Fairsky Shipping & Trading S.A.	Greece	www.fairsky.gr	14	737,462
30	Franco Compania Naviera SA	Greece	www.franco.gr	8	293,480
31	Gestioni Armatoriali SpA	Italy	gestioniarmatoriali.it	13	894,850
32	Genco Shipping & Trading Ltd	USA	www.gencoshipping.com	53	3,808,009
33	Goldenport Shipmanagement Ltd	Greece	www.goldenport.gr	27	1,378,193
34	Gourdomichalis Maritime SA	Greece	www.gmsa.gr	6	397,350
35	Grecomar Shipping Agency Ltd	Greece	-	3	127,076
36	Grieg Star Shipping AS	Norway	www.griegstar.com	25	1,069,405
37	Hebei Ocean Shipping Co Ltd	P.R. China	www.hoscogroup.com	28	4,756,874
38	Hong Kong Ming Wah Shipping Co Ltd	Hong Kong SAR	www.hkmw.com.hk	36	5,594,878
39	IMC Shipping Co PTE Ltd	Singapore	www.imcgroup.info	32	1,990,931
40	Interorient Navigation	Cyprus	www.interorient.com	66	2,749,348
41	K Line Bulk Shipping (UK) Limited	United Kingdom	www.klinebulkuk.com	29	3,528,452
42	Kassian Maritime Navigation Agency Ltd	Greece	-	7	456,798
43	Kouros Maritime Enterprises	Greece	www.kourosmar.gr	1	36,537
44	Kristen Marine S.A	Greece	www.kristen.gr	18	854,495
45	Kyla Shipping Enterprises Corp	Greece	-	5	584,953
46	Lyras Shipping Ltd	Greece	www.paralosmaritime.com	1	35,730
47	NS Lemos & Co Ltd	Greece	www.nslemos.com	8	1,352,174
48	Liberty Maritime Corporation	USA	www.libertymar.com	9	409,108
49	Marine Trust Ltd	Greece	-	27	3,802,504
50	Mitsui OSK Lines Ltd	Japan	www.mol.co.jp	394	16,859,123
51	Newfront Shipping	Greece	www.newfrontship.com	2	147,670
52	NYK Line	Japan	www.nyk.com	750	51,026,250
53	Oak Maritime (HK) Inc Ltd	Hong Kong SAR	www.snc.com.tw	15	2,224,191
54	Oceanbulk Maritime SA	Greece	www.oceanbulk.gr	2	339,036
55	Odysea Carriers SA	Greece	www.odyseacarriers.gr/	6	401,733
56	Olympic Shipping and Management S.A.	Greece	www.olyship.com	15	2,515,184
57	Orion Bulkers GmbH & Co KG	Germany	www.orionbulkers.com	18	1,574,422
58	Pacific Basin Shipping (HK) Ltd	Hong Kong SAR	www.pacificbasin.com	30	921,517
59	Pacific Carriers Ltd	Singapore	www.pclsg.com	74	3,762,916
60	A G Pappadakis & Co Ltd	Greece	-	7	247,573
61	Paragon Shipping Inc	Greece	www.paragonship.com	11	747,994
62	Pasifik Gemi Isletmeciligi ve Ticaret A.S.	Turkey	www.kiran.com.tr	22	615,220
63	Plutofylax Shipping Corporation	Greece	-	2	164,000
64	Premuda Bulk Navegacao LDA	Italy	www.premuda.net	18	1,393,800
65	Ranger Marine SA	Greece	-	4	175,961
66	Rethymnis & Kulukundis Ltd	United Kingdom	www.randk.co.uk	4	207,236
67	Rio Tinto Shipping Ltd	United Kingdom	www.marine.riotinto.com	5	449,526
68	Sanko Steamship Co Ltd	Japan	www.sankoline.co.jp	40	2,289,452
69	Scinicariello Ship Management SpA	Italy	scini.cafima.it	10	955,576
70	Shell International Trading and Shipping	United Kingdom	www.shell.co.uk	25	2,640,461
71	Shipping Corporation of India	India	www.shipindia.com	34	2,689,670
72	Sinotrans Shipping Ltd	Hong Kong SAR	www.sinotranship.com	46	2,807,751
73	SK Shipping	South Korea	www.skshipping.com	38	5,487,894
74	Star Bulk Management, Inc	Greece	www.starbulk.com	11	922,325
75	Sun Enterprises Ltd	Greece	www.sunenterprises.gr	18	1,983,522
76	Teo Shipping Corporation	Greece	-	8	528,662
77	Tomasos Brothers Inc	Greece	www.tomasos.gr	13	524,166
78	Tsakos Columbia Ship-Management (TCM) S.A	Greece	www.tcsm.gr	65	5,966,237
79	U.S. United Ocean Services LLC	USA	www.unitedmaritimegroup.com	3	103,642
80	Unisea Shipping Ltd	Greece	-	2	230,000
81	Valles Steamship (Canada) Ltd	Hong Kong SAR	www.vallesgroup.com	13	1,270,945
82	Victoria Steamship Co Ltd	United Kingdom	www.vicsteam.co.uk	9	477,353
83	Zela Shipping Company Ltd	United Kingdom	www.zelashipping.com	6	1,050,974

A.2 Membership list of INTERTANKO

Table A.2 Membership list of INTERTANKO (as of August, 2011)

No.	Marine shipping firm name	Location	Corporate website	Ships	Approx. DWT
1	A.P. Møller	Denmark	www.maersktankers.com	574	33,558,362
2	A/S J Ludwig Mowinckels Rederi	Norway	www.jlmr.no	9	333,431
3	Admanthos Shipping Agency Inc	USA	www.admanthos.com	4	179,993
4	Aegean Shipping Management SA	Greece	www.aegeanoil.gr	14	204,860
5	Aeolos Management SA	Greece	-	13	2,258,037
6	AET Shipmanagement (Singapore) Pte Ltd	Singapore	www.aet-tankers.com	86	10,664,116
7	Akar Deniz Tas Ve Tic Ltd STI (AKAR Group)	Turkey	www.akarshipping.com	9	119,648
8	Alberta Shipbrokers Ltd.	United Kingdom	www.samossteamship.gr	18	1,828,013
9	Almi Tankers SA	Greece	www.almitankers.gr	2	220,427
10	Ancora Investment Trust Inc	Greece	www.ancora.gr	16	532,164
11	Anglo-Atlantic Steamship Company Limited	Sweden	www.laurinmaritime.com	14	635,968
12	Antares Naviera S.A.	Argentina	www.antaresnaviera.com	9	388,061
13	Arcadia Shipmanagement Co Ltd	Greece	www.arcadiasm.gr	14	1,743,382
14	Asterion Tanker Navigation GmbH & Co. KG	Germany	www.stellamarine.de	7	299,268
15	Athenian Sea Carriers Ltd	Greece	www.atheniangroup.com	5	1,428,933
16	Atlas Maritime Ltd	Greece	www.atlasmaritime.eu	6	647,678
17	Avin International SA	Greece	www.avin.gr	20	814,875
18	Awilco AS	Norway	www.awilco.no	3	464,271
19	B+H Management Ltd.	Bermuda	www.bhocean.com	6	479,877
20	Bergshav Management A/S	Norway	www.bergshav.com	12	573,342
21	Bernhard Schulte Shipmanagement	Cyprus	www.bs-shipmanagement.com	26	1,105,822
22	Besiktas Shipping Group	Turkey	www.besiktasgroup.com	18	1,114,000
23	Calisa SpA	Italy	www.calisa.it	3	108,791
24	Capital Ship Management Corp.	Greece	www.capitalship.gr	36	2,951,272
25	Carl Büttner GmbH & Co KG	Germany	www.carlbuettner.de	11	213,516
26	Champion Tankers A/S	Norway	www.champion-tankers.no	11	469,733
27	Chemnav Shipmanagement Ltd	Greece	www.chemnav.gr	5	125,695
28	Chronos Shipping Co Ltd	Greece	www.chronos-ship.gr	5	142,284
29	Claus-Peter Offen Tankschiffreederei GmbH & Co KG	Germany	www.offentankers.de	16	713,909
30	Columbia Shipmanagement	Cyprus	www.columbia-shipmanagement.com	59	2,507,251
31	Concordia Maritime AG	Switzerland	www.concordiamaritime.com	12	800,965
32	Consolidated Marine Management Inc	Greece	www.cmm.gr	9	477,976
33	d'Amico Societá di Navigazione SpA	Italy	www.damicotankers.com	54	2,850,901
34	Dalmare SpA	Italy	www.dalesio.it	12	313,589
35	Dampskibsselskabet NORDEN A/S	Denmark	www.ds-norden.com	33	2,656,464
36	Dannebrog Rederi AS	Denmark	www.dannebrog.com	19	642,143
37	Delta Tankers Ltd	Greece	www.deltatankers.gr	43	5,278,029
38	Diamlemos Shipping Corporation	Greece	-	9	662,286
39	Dolphin Tanker Srl	Italy	www.grupposcerni.it	8	1,173,221
40	Dorian (Hellas) SA	Greece	www.dorianhellas.com	6	391,751
41	Dr Peters Group (DS Schiffahrt GmbH & Co KG)	Germany	www.ds-schiffahrt.de	22	656,399
42	DSD Shipping AS	Norway	www.dsd-shipping.no	12	971,596
43	Dunya Denizcilik Ve Ticaret AS	Turkey	www.dunyashipping.com	7	478,136
44	Duzgit Shipholding Ltd	Turkey	www.duzgit.com	3	17,050
45	Eitzen Chemical ASA	Norway	www.eitzen-chemical.com	83	1,485,657
46	Eletson Corporation	Greece	www.eletson.com	28	1,726,260
47	Empire Navigation Inc	Greece	www.empirenavigation.com	8	1,340,301
48	Empresa Naviera ELCANO, S.A.	Spain	www.navieraelcano.com	21	1,142,268
49	Epic Ship Management Pte Ltd.	Singapore	www.epicshipping.com	15	62,397
50	Ernst Jacob GmbH & Co KG	Germany	www.ernstjacob.de	15	1,443,757
51	Essar Shipping Ports and Logistics Limited	India	www.essar.com	19	1,407,028
52	Estoril Navigation Ltd	Greece	www.estorilnav.com	4	342,204
53	Euronav NV	Belgium	www.euronav.com	17	2,633,306
54	Euronav Ship Management Hellas Ltd.	Greece	www.euronav.com	18	4,946,510
55	Exmar Shipmanagement NV	Belgium	www.exmar.be	34	1,160,178
56	Expedo Ship Management (Canada) Ltd	Canada	www.expedoship.com	6	443,469
57	FAL Shipping Co Ltd	United Arab Emir.	www.falgroup.com	12	745,784
58	Finaval SpA	Italy	www.finaval.com	11	855,211
59	Finbeta SpA	Italy	www.finbeta.com	8	76,085
60	First Olsen AS	Norway	www.fotl.no	2	328,056
61	Fratelli d'Amico Armatori SpA	Italy	www.damicofratelli.it	11	1,390,213
62	Frontline Ltd	Norway	www.frontline.bm	73	18,079,736
63	Genel Denizcilik Nakliyati AS	Turkey	www.gedenlines.com	38	3,649,573
64	General Maritime Management LLC	USA	www.generalmaritimecorp.com	34	5,306,921
65	General National Maritime Transport Company	Libya	www.gnmtc.com	24	2,118,610
66	German Tanker Shipping GmbH & Co KG	Germany	www.german-tanker.de	13	464,670
67	Groton Pacific Carriers Inc.	USA	www.grotonpacific.com	2	203,684
68	Grupo TMM, S.A.	Mexico	www.grupotmm.com	9	351,222
69	Gulf Energy Maritime (GEM) PJSC	United Arab Emir.	www.gemships.com	17	989,000
70	Gungen Maritime & Trading AS	Turkey	www.gungen.com	2	303,167
71	Hanjin Shipping Co., Ltd	South Korea	www.hanjin.com	170	13,336,465
72	Harren & Partner Ship Management GmbH & Co KG	Germany	www.harren-partner.de	56	676,353
73	Hellespont Ship Management GmbH & Co KG	Germany	www.hellespont.com	22	1,411,182
74	Hellespont Steamship Corporation	Greece	www.hellespont.com	7	73,685
75	Histria Shipmanagement Srl	Romania	www.histria.ro	10	449,689
76	Iino Kaiun Kaisha Ltd.	Japan	www.iino.co.jp	81	5,069,834
77	India Steamship Co. Ltd.	India	www.indiasteamship.com	6	623,871

Table A.2 Membership list of INTERTANKO (as of August, 2011) cont.

No.	Marine shipping firm name	Location	Corporate website	Ships	Approx. DWT
78	International Tanker Management Holding Ltd	United Arab Emir.	www.tankermanager.com	30	5,553,646
79	J B Ugland Shipping Singapore Pte Ltd	Singapore	www.sivashipping.com	33	1,506,589
80	John T Essberger GmbH & Co KG	Germany	www.rantzau.de	29	168,356
81	K Tankercilik Ve Gemi Isletmeciligi AS	Turkey	www.kaptanoglu.com	0	600,000
82	Kawasaki Kisen Kaisha, Ltd.	Japan	www.kline.co.jp	22	3,796,245
83	Knutsen OAS Shipping A/S	Norway	www.knutsenoas.com	47	3,768,795
84	Kristian Gerhard Jebsen Skipsrederi A/S	Norway	www.kgjs.no	49	3,826,753
85	Latvian Shipping Company	Latvia	www.lk.lv	20	939,681
86	Lauritzen Tankers A/S	Denmark	www.j-lauritzen.com	80	4,243,262
87	Liquimar Tankers Management Inc	Greece	www.liquimar.gr	7	942,993
88	Lundquist Shipping Company	Finland	www.lundqvist.aland.fi	8	819,984
89	Marine Management Services MC	Greece	www.mms.gr	12	1,479,345
90	Marinvest Shipping AB	Sweden	www.marinvest.se	12	775,773
91	Marnavi SpA	Italy	www.marnavi.it	12	123,502
92	Marwave Shipmanagement B.V.	Netherlands	www.marwave.com	14	998,000
93	Medcare Shipping SA	Greece	www.medcare.gr	4	191,138
94	Mega Chemicals AG	Switzerland	mega-chemicals.ch	8	161,914
95	Meiji Shipping Co. Ltd.	Japan	www.meiji-group.com	35	3,305,000
96	Metrostar Management Corporation	Greece	www.metrostar.gr	5	200,281
97	Millenia Maritime Inc	Greece	www.milleniamaritime.gr	10	393,870
98	Minerva Marine Inc	Greece	www.minervamarine.com	42	5,000,265
99	MISC Berhad	Malaysia	www.misc.com.my	60	4,822,561
100	Motia Compagnia di Navigazione SpA	Italy	www.motia.it	11	409,553
101	Nakkas Shipping & Trading Co Ltd	Turkey	www.nakkas.com.tr	4	54,047
102	Navieras Ultragas Ltda.	Chile	www.ultragas.cl	21	636,164
103	Navigazione Montanari SpA	Italy	www.navmont.com	28	1,764,304
104	Navios Tankers Management Inc	Greece	www.navios.com	59	7,117,284
105	Nissho Shipping Co. Ltd.	Japan	www.nissho-shipping.co.jp	36	1,992,260
106	NITC	Iran	www.nitc-tankers.com	39	9,604,000
107	Nordic American Tanker Shipping Ltd.	Norway	www.nat.bm	17	2,653,107
108	Novorossiysk Shipping Company	Russia	www.novoship.ru	51	4,697,616
109	NS UNITED KAIUN KAISHA, LTD	Japan	www.nsuship.co.jp	18	2,609,166
110	Odfjell SE	Norway	www.odfjell.com	55	1,655,046
111	Olympic Gulf Tankers Co Ltd	Greece	www.ogt.gr	1	14,371
112	Omega Navigation Enterprises Inc	Greece	www.omeganavigation.com	15	905,040
113	OSG Ship Management Inc (GR LTD.)	Greece	www.osg.com	29	1,439,404
114	Paradise Navigation SA	Greece	www.paradisenet.gr	4	291,333
115	Parakou Ship Management Pte Ltd	Singapore	www.parakougroup.com	33	1,900,100
116	PB Tankers SpA	Italy	www.pietrobarbaro.com	8	394,896
117	Perseveranza SpA	Italy	www.perseveranzaspa.com	15	951,926
118	Polyar Shipping Co Ltd	Greece	-	23	1,332,874
119	Pratibha Shipping Company Ltd	India	www.pscl.org	7	374,915
120	Prime Marine Management Inc	Greece	www.prime-marine.net	31	1,817,716
121	Primorsk Shipping Corporation	Russia	www.prisco.ru	21	1,892,221
122	Qatar Shipping Company S.P.C.	Qatar	www.qship.com	7	426,271
123	Rederi AB Gotland	Sweden	www.gotlandsbolaget.se	14	400,500
124	Rigel Schiffahrts GmbH & Co KG	Germany	www.rigel-hb.com	31	551,602
125	Roxana Shipping SA	Greece	www.roxanashipping.com	12	588,072
126	Sanmar Shipping Corporation	India	www.sanmargroup.com	6	330,945
127	Scorpio Ship Management SAM	Monaco	www.scorpio.mc	12	744,657
128	Scorship Navigation GmbH & Co. KG	Germany	www.scorship.de	22	1,426,223
129	Sea Pioneer Shipping Corp	Greece	www.sea-pioneer.com	4	303,233
130	Seaarland Shipping Management BV	Netherlands	www.seaarland.nl	6	417,734
131	Seacrest Shipping Co Ltd	United Kingdom	www.seacrestshipping.com	3	118,570
132	Socatra	France	www.socatra.com	10	224,720
133	SOCOMAR Srl	Italy	www.socomar.eu	5	221,400
134	Stealth Maritime Corporation SA	Greece	www.stealth.gr	19	1,580,903
135	Stena Bulk AB	Sweden	www.stenabulk.com	77	8,215,725
136	Stolt Tankers BV	Netherlands	www.stolt-nielsen.com	90	2,135,156
137	Tankerska Plovidba	Croatia	www.tankerska.hr	20	1,564,956
138	Tarntank Chartering AB	Sweden	www.tarntank.se	9	108,737
139	Teekay Shipping (Canada) Ltd.	Canada	www.teekay.com	152	18,623,331
140	Thenamaris Ships Management Inc	Greece	www.thenamaris.gr	41	4,110,615
141	Tokyo Marine Co. Ltd.	Japan	www.tokyomarine.net	63	1,306,381
142	TOP Ships Inc	Greece	www.topships.org	7	351,637
143	TORM A/S	Denmark	www.torm.com	85	5,183,555
144	Tradewind Tankers S.A.	Spain	www.tradewindtankers.com	8	78,339
145	Transmarine Management APS	Denmark	www.transmarine.dk	2	12,184
146	Trinity Ships Inc	Greece	www.trinityships.com	1	44,646
147	Tschudi Shipping Company A/S	Norway	www.tschudishipping.com	7	24,200
148	Uglands Rederi, AS	Norway	www.jjuc.no	15	1,000,041
149	Unicom Management Services (Cyprus) Ltd	Cyprus	www.unicom-cy.com	69	5,517,842
150	Unicorn Shipping (Grindrod LTD)	South Africa	www.unicorn.co.za	11	275,500
151	Othello Shipping Company	Denmark	www.othelloship.dk	15	133,360
152	SLOMAN NEPTUN Schiffahrts-Aktiengesellschaft	Germany	www.sloman-neptun.com	18	198,327
153	Varun Shipping Company Limited	India	www.varunship.com	13	656,392
154	Viken Shipping AS	Norway	www.vikenshipping.com	15	1,033,977
155	Wappen Reederei GmbH & Co KG	Germany	www.wappen-reederei.de	13	101,882
156	Westfal-Larsen Management AS	Norway	www.wlco.no	11	497,111
157	Wisby Shipmanagement	Sweden	www.wisbytankers.se	5	32,722
158	YASA Tankercilik Ve Tasimacilik AS	Turkey	www.yasahold.com.tr	11	1,117,681

A.3 Layout of survey data collection instrument (PDF version)

Academic Research Questionnaire

in Engine Maintenance Management

WARWICK BUSINESS SCHOOL - OPERATIONS MANAGEMENT GROUP

wbs
WARWICK BUSINESS SCHOOL

Throughout this questionnaire, you will be asked to express your company's view on topics related to the following activities of Planned and Non-Planned Maintenance of your ships' main engines.

Ship's Engine Maintenance

Planned Maintenance
Maintaining an engine through preventative and regular interval service

- **Engine Maintenance Planning** – Setting up the plan/schedule according to which an engine is serviced
- **Tactical Spare Part Logistics** – Supplying the spare parts for the regular service of an engine
- **Regular Engine Maintenance** – Servicing / maintaining / overhauling the engine

Non-Planned Maintenance
Repairing an engine in the case of failure or unexplained poor performance

- **Engine Problem Troubleshooting** – Determining the cause of a problem and setting a plan to solve it
- **Extraordinary Spare Part Logistics** – Supplying the spare parts for the extraordinary repair of an engine
- **Extraordinary Engine Repairs** – Repairing the engine to fix the identified problem

COMPANY BACKGROUND

CB1: How long has your company been engaged in deep sea shipping?
Approximate number of years:

CB2: How many employees does your company have?
Number of on-shore employees:
Number of employees at sea:

CB3: What is approximately your ships' total dead weight tonnage?
Approximate total DWT of all ships:

CB4: What is the average age of the ships that your company owns or controls?
Approximate number of years:

CB5: How many ships does your company own and how many ships does it control through bareboat charter contracts?

	Dry Cargo Ships	*Wet Cargo Ships*	*Container Ships*	*LPG/LNG Carriers*	*Reefer Ships*	*Other Ships*
Ships owned:						
Ships controlled (bareboat charters):						

SECTION 1 - MANAGING ENGINE MAINTENANCE

S1.1: Who is responsible for your ships' Planned Engine Maintenance function?
Please distribute 100 percentage points per activity (column):

	Engine maintenance planning	*Tactical spare part logistics*	*Regular engine maintenance*
Our company or subsidiary/sister firm:	%	%	%
Engine designer/manufacturer:	%	%	%
Collaborating shipyard:	%	%	%
Third-party associate:	%	%	%
Total:	100 %	100 %	100 %

Engine Maintenance Management Questionnaire - Section 1 WARWICK BUSINESS SCHOOL **P1/P9**

S1.2: Who actually performs your ships' Planned Engine Maintenance?

Please distribute 100 percentage points per activity (column):

	Engine maintenance planning	*Tactical spare part logistics*	*Regular engine maintenance*
Our company or subsidiary/sister firm:	%	%	%
Engine designer/manufacturer:	%	%	%
Collaborating shipyard:	%	%	%
Third-party associate:	%	%	%
Total:	100 %	100 %	100 %

S1.3: Who is responsible for your ships' Non-Planned Engine Maintenance function?

Please distribute 100 percentage points per activity (column):

	Engine problem troubleshooting	*Extraordinary spare part logistics*	*Extraordinary engine repairs*
Our company or subsidiary/sister firm:	%	%	%
Engine designer/manufacturer:	%	%	%
Collaborating shipyard:	%	%	%
Third-party associate:	%	%	%
Total:	100 %	100 %	100 %

S1.4: Who actually performs your ships' Non-Planned Engine Maintenance?

Please distribute 100 percentage points per activity (column):

	Engine problem troubleshooting	*Extraordinary spare part logistics*	*Extraordinary engine repairs*
Our company or subsidiary/sister firm:	%	%	%
Engine designer/manufacturer:	%	%	%
Collaborating shipyard:	%	%	%
Third-party associate:	%	%	%
Total:	100 %	100 %	100 %

SECTION 2 - ENGINE MAINTENANCE CHARACTERISTICS

S2.1: How often do you engage in or need each activity?

	0–1 *every five years*	1–2 *every two years*	2–3 *every year*	3–4 *every semester*	4–5 *every month*	5–6 *every week*	6–7 *every day*
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

S2.2: How difficult is it to predict your company's demand for each activity?

	0–1 *not at all*	1–2	2–3 *slightly difficult*	3–4	4–5 *quite difficult*	5–6	6–7 *extremely difficult*
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

S2.3: How many of your firm's employees are assigned to each activity?

	number of employees:
Engine maintenance planning:	
Engine problem troubleshooting:	
Tactical spare part logistics:	
Extraordinary spare part logistics:	
Regular engine maintenance:	
Extraordinary engine repairs:	

S2.4: How difficult is it to find and recruit experienced professionals for each activity?

	0–1 *not at all*	1–2	2–3 *slightly difficult*	3–4	4–5 *quite difficult*	5–6	6–7 *extremely difficult*
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

S2.5: **How well-defined are the tasks included in each activity?**

	not at all		slightly defined		quite defined		extremely defined
	0 – 1	1 – 2	2 – 3	3 – 4	4 – 5	5 – 6	6 – 7
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

S2.6: **How complicated are the tasks included in each activity?**

	not at all		slightly complex		quite complex		extremely complex
	0 – 1	1 – 2	2 – 3	3 – 4	4 – 5	5 – 6	6 – 7
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

S2.7: **How difficult is it to price the tasks included in each activity?**

	not at all		slightly difficult		quite difficult		extremely difficult
	0 – 1	1 – 2	2 – 3	3 – 4	4 – 5	5 – 6	6 – 7
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

S2.8: **How rapid are technological developments in tools, methods and equipment in each activity?**

	not at all		slightly rapid		quite rapid		extremely rapid
	0 – 1	1 – 2	2 – 3	3 – 4	4 – 5	5 – 6	6 – 7
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

S2.9: **How predictable are technological developments in each activity?**

	not at all		slightly predictable		quite predictable		extremely predictable
	0 – 1	1 – 2	2 – 3	3 – 4	4 – 5	5 – 6	6 – 7
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

S2.10: **How critical is each activity to your company's ability to conduct business?**

	not at all		slightly critical		quite critical		extremely critical
	0 – 1	1 – 2	2 – 3	3 – 4	4 – 5	5 – 6	6 – 7
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

S2.11: How important is timing and on-time delivery in each activity?

	0	1	2	3	4	5	6	7
		not at all		*slightly important*		*quite important*		*extremely important*
Engine maintenance planning:								
Engine problem troubleshooting:								
Tactical spare part logistics:								
Extraordinary spare part logistics:								
Regular engine maintenance:								
Extraordinary engine repairs:								

S2.12: How important is good performance in each activity to your company's reputation?
(i.e. poor performance hurts your company's reputation)

	0	1	2	3	4	5	6	7
		not at all		*slightly important*		*quite important*		*extremely important*
Engine maintenance planning:								
Engine problem troubleshooting:								
Tactical spare part logistics:								
Extraordinary spare part logistics:								
Regular engine maintenance:								
Extraordinary engine repairs:								

S2.13: To what degree does each activity allow you to offer your services at higher prices compared to your competitors?

	0	1	2	3	4	5	6	7
		not at all		*slightly*		*quite*		*extremely*
Engine maintenance planning:								
Engine problem troubleshooting:								
Tactical spare part logistics:								
Extraordinary spare part logistics:								
Regular engine maintenance:								
Extraordinary engine repairs:								

S2.14: How likely is each activity to allow you to offer your services at higher prices compared to your competitors in the future?

	0	1	2	3	4	5	6	7
		not likely at all		*slightly likely*		*quite likely*		*extremely likely*
Engine maintenance planning:								
Engine problem troubleshooting:								
Tactical spare part logistics:								
Extraordinary spare part logistics:								
Regular engine maintenance:								
Extraordinary engine repairs:								

S2.15: To what degree does each activity increase the benefits perceived by your customers?

	0	1	2	3	4	5	6	7
		not at all		*slightly*		*quite*		*extremely*
Engine maintenance planning:								
Engine problem troubleshooting:								
Tactical spare part logistics:								
Extraordinary spare part logistics:								
Regular engine maintenance:								
Extraordinary engine repairs:								

S2.16: To what degree does each activity allow you to compete on costs?

	0	1	2	3	4	5	6	7
		not at all		*slightly*		*quite*		*extremely*
Engine maintenance planning:								
Engine problem troubleshooting:								
Tactical spare part logistics:								
Extraordinary spare part logistics:								
Regular engine maintenance:								
Extraordinary engine repairs:								

S2.17: **How likely is each activity to allow you to compete on costs in the future?**

	0	*not likely at all* 1	2	*slightly likely* 3	4	*quite likely* 5	6	*extremely likely* 7
Engine maintenance planning:								
Engine problem troubleshooting:								
Tactical spare part logistics:								
Extraordinary spare part logistics:								
Regular engine maintenance:								
Extraordinary engine repairs:								

S2.18: **How connected is each activity to the rest of your company's operations?**

	0	*not at all* 1	2	*slightly connected* 3	4	*quite connected* 5	6	*extremely connected* 7
Engine maintenance planning:								
Engine problem troubleshooting:								
Tactical spare part logistics:								
Extraordinary spare part logistics:								
Regular engine maintenance:								
Extraordinary engine repairs:								

S2.19: **How visible is each activity in formal performance measures in your company?**

	0	*not at all* 1	2	*slightly visible* 3	4	*quite visible* 5	6	*extremely visible* 7
Engine maintenance planning:								
Engine problem troubleshooting:								
Tactical spare part logistics:								
Extraordinary spare part logistics:								
Regular engine maintenance:								
Extraordinary engine repairs:								

SECTION 3 - PROCURING ENGINE MAINTENANCE (BUYER'S SIDE)

S3.1: **Approximately how many suppliers do you use for each activity** *(number of suppliers used)*,
and from how many other suppliers can you realistically procure each activity *(number of other suppliers)* **?**

	number of suppliers used:	*number of other suppliers:*	Not Applicable
Engine maintenance planning:			
Engine problem troubleshooting:			
Tactical spare part logistics:			
Extraordinary spare part logistics:			
Regular engine maintenance:			
Extraordinary engine repairs:			

S3.2: **To switch to a *different* supplier for each activity, to what degree do you need to change your company's know-how?**

	0	*not at all* 1	2	*slightly* 3	4	*quite* 5	6	*extremely* 7
Engine maintenance planning:								
Engine problem troubleshooting:								
Tactical spare part logistics:								
Extraordinary spare part logistics:								
Regular engine maintenance:								
Extraordinary engine repairs:								

S3.3: **To switch to a *different* supplier for each activity, to what degree do you need to change your company's human resources?**

	0	*not at all* 1	2	*slightly* 3	4	*quite* 5	6	*extremely* 7
Engine maintenance planning:								
Engine problem troubleshooting:								
Tactical spare part logistics:								
Extraordinary spare part logistics:								
Regular engine maintenance:								
Extraordinary engine repairs:								

S3.4: **To switch to a *different* supplier for each activity, to what degree do you need to change your company's operating procedures?**

	not at all 0	1	2	*slightly* 3	4	*quite* 5	6	*extremely* 7
Engine maintenance planning:								
Engine problem troubleshooting:								
Tactical spare part logistics:								
Extraordinary spare part logistics:								
Regular engine maintenance:								
Extraordinary engine repairs:								

S3.5: **To switch to a *different* supplier for each activity, to what degree do you need to change your company's technical infrastructure?**
(e.g. hardware, software or other technical equipment)

	not at all 0	1	2	*slightly* 3	4	*quite* 5	6	*extremely* 7
Engine maintenance planning:								
Engine problem troubleshooting:								
Tactical spare part logistics:								
Extraordinary spare part logistics:								
Regular engine maintenance:								
Extraordinary engine repairs:								

S3.6: **How difficult is it to fully develop each activity internally?**
(in terms of time and money)

	not at all 0	1	2	*slightly difficult* 3	4	*quite difficult* 5	6	*extremely difficult* 7
Engine maintenance planning:								
Engine problem troubleshooting:								
Tactical spare part logistics:								
Extraordinary spare part logistics:								
Regular engine maintenance:								
Extraordinary engine repairs:								

S3.7: **How difficult is it to evaluate a supplier's performance in each activity?**

	not at all 0	1	2	*slightly difficult* 3	4	*quite difficult* 5	6	*extremely difficult* 7
Engine maintenance planning:								
Engine problem troubleshooting:								
Tactical spare part logistics:								
Extraordinary spare part logistics:								
Regular engine maintenance:								
Extraordinary engine repairs:								

SECTION 4 - PROCURING ENGINE MAINTENANCE (SUPPLIER'S SIDE)

S4.1: **Approximately how many other firms do your suppliers serve in each activity** *(number of other firms served)*, **and how many additional firms could realistically make use of their services** *(number of potential client firms)* **?**

	number of other client firms:	*number of potential client firms:*	Not Applicable
Engine maintenance planning:			
Engine problem troubleshooting:			
Tactical spare part logistics:			
Extraordinary spare part logistics:			
Regular engine maintenance:			
Extraordinary engine repairs:			

S4.2: **How specialized is your suppliers' know-how to your company's particular needs?**
In each activity:

	not at all 0	1	2	*slightly specialized* 3	4	*quite specialized* 5	6	*extremely specialized* 7
Engine maintenance planning:								
Engine problem troubleshooting:								
Tactical spare part logistics:								
Extraordinary spare part logistics:								
Regular engine maintenance:								
Extraordinary engine repairs:								

S4.3: How specialized are your suppliers' human resources to your company's particular needs?
In each activity:

	0	1	2	3	4	5	6	7
	not at all		*slightly specialized*		*quite specialized*		*extremely specialized*	
Engine maintenance planning:								
Engine problem troubleshooting:								
Tactical spare part logistics:								
Extraordinary spare part logistics:								
Regular engine maintenance:								
Extraordinary engine repairs:								

S4.4: How specialized are your suppliers' operating procedures to your company's particular needs?
In each activity:

	0	1	2	3	4	5	6	7
	not at all		*slightly specialized*		*quite specialized*		*extremely specialized*	
Engine maintenance planning:								
Engine problem troubleshooting:								
Tactical spare part logistics:								
Extraordinary spare part logistics:								
Regular engine maintenance:								
Extraordinary engine repairs:								

S4.5: How specialized is your suppliers' technical infrastructure to your company's particular needs?
(e.g. hardware, software or other technical equipment)
In each activity:

	0	1	2	3	4	5	6	7
	not at all		*slightly specialized*		*quite specialized*		*extremely specialized*	
Engine maintenance planning:								
Engine problem troubleshooting:								
Tactical spare part logistics:								
Extraordinary spare part logistics:								
Regular engine maintenance:								
Extraordinary engine repairs:								

S4.6: Approximately how much of your supplier's business (income) do you represent?
In each activity, expressed as a percentage:

	Contribution to supplier income (%):	Not Applicable
Engine maintenance planning:		
Engine problem troubleshooting:		
Tactical spare part logistics:		
Extraordinary spare part logistics:		
Regular engine maintenance:		
Extraordinary engine repairs:		

S4.7: How much does timing and on-time delivery influence supplier compensation in each activity?

	0	1	2	3	4	5	6	7
	not at all		*slightly*		*quite*		*extremely*	
Engine maintenance planning:								
Engine problem troubleshooting:								
Tactical spare part logistics:								
Extraordinary spare part logistics:								
Regular engine maintenance:								
Extraordinary engine repairs:								

S4.8: How visible is your suppliers' performance in the activity to other companies in your sector?
For each activity:

	0	1	2	3	4	5	6	7
	not at all		*slightly visible*		*quite visible*		*extremely visible*	
Engine maintenance planning:								
Engine problem troubleshooting:								
Tactical spare part logistics:								
Extraordinary spare part logistics:								
Regular engine maintenance:								
Extraordinary engine repairs:								

S4.9: How financially secure are your suppliers in general?

In each activity:

	not at all		*slightly secure*		*quite secure*		*extremely secure*
	0 1	2	3	4	5	6	7
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

SECTION 5 - RELATIONS WITH SUPPLIERS

S5.1: How often do suppliers gain information about your operations that would be valuable to your competitors?

In each activity:

	hardly ever		*sometimes*		*usually*		*all the time*
	0 1	2	3	4	5	6	7
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

S5.2: How often do you gain information about your supplier's operations that would be valuable to their competitors?

In each activity:

	hardly ever		*sometimes*		*usually*		*all the time*
	0 1	2	3	4	5	6	7
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

S5.3: How reliable do you think that the suppliers are?

In each activity:

	not at all		*slightly*		*quite*		*extremely*
	0 1	2	3	4	5	6	7
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

S5.4: To what degree can your company influence your suppliers' strategic decisions?

In each activity:

	not at all		*slightly*		*quite*		*extremely*
	0 1	2	3	4	5	6	7
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

SECTION 6 - VARIOUS ORGANIZATIONAL ISSUES

S6.1: How aligned is each activity with your company's corporate identity?

	not at all		*slightly aligned*		*quite aligned*		*extremely aligned*
	0 1	2	3	4	5	6	7
Engine maintenance planning:							
Engine problem troubleshooting:							
Tactical spare part logistics:							
Extraordinary spare part logistics:							
Regular engine maintenance:							
Extraordinary engine repairs:							

S6.2: **To what degree is your sourcing strategy influenced by industry regulating and other organizations?**
(e.g. the IMO, classification societies, underwriters, etc.)

	not at all		*slightly*		*quite*		*extremely*
0	1	2	3	4	5	6	7

S6.3: **To what degree is your sourcing strategy influenced by other shipping firms?**
(e.g. Shipping Associations, industry leaders, etc.)

	not at all		*slightly*		*quite*		*extremely*
0	1	2	3	4	5	6	7

About this research:

This research is part of a doctoral study conducted at the Business School of the University of Warwick.

The study is not funded by any corporate organization, nor does it represent any interests in the shipping industry.

All the information provided through this questionnaire are treated with strict confidence.

For any inquiries, please contact:

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A.4 Sample cover letter delivered during the survey's administration

Dear Mr. Jones,

Following our communication, I forward you further information about the research. I am currently undertaking my doctoral thesis at the Warwick Business School of the University of Warwick in England.

The study explores the differences between companies that outsource and companies that do not outsource the maintenance of their ships' main engines. Focus is put on management and strategic considerations rather than specific technical issues. The sample of the research is the membership of INTERCARGO and INTERTANKO.

All participating companies will receive a collective results report once the data analysis process is complete. The results will, among other things, allow you to see how other companies in the industry handle the maintenance of their ships' main engines, and will give you a sense of their circumstances and considerations.

The study's questionnaire is entirely confidential and is administered through the internet via a secure on-line survey system. For your consideration, I also attach a sample of the questionnaire in document format (pdf).

To complete (or continue) the questionnaire, please follow the link below:
${l://SurveyURL}

The survey system has an automatic **'save and continue'** feature which allows you to complete the questionnaire in stages. If you wish to interrupt, simply close the internet browser. If you wish to continue, please follow the survey link again.

The deadline for the survey is [month], [day]th 2012.

This research is not funded by any corporate organization and does not represent any interests in the shipping industry.

Concerning my person, I hold a Dipl.-Eng. in Production Engineering & Management from the Technical University of Crete (2006) as well as an MSc in Engineering Management from the same school (2008). As of 2009, I am a scholar PhD candidate at the Operations Management group of Warwick Business School.

I fully recognize that the survey requires the sacrifice of valuable time on your behalf, and I deeply appreciate your attention and contribution.

For any clarification or inquiry, I remain at your disposal.

Sincerely yours,
Emmanouil Alvizos

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Appendix B

B.1 Aggregated dataset sample (maintenance activity level)

Case No.	ActivityOutsourcing	Cat2ActivityOutsourcing	CompanySizeShipDWT_TRlog10	PrinHumAssetSpecificity	PrinPhysAssetSpecificity	PrinDedAssetSpecificity	PrinProcAssetSpecificity	PrinTemporalSpecificity	PrinBrandCapExposure	PrinPropInfoExposure	AgenHumAssetSpecificity	AgenPhysAssetSpecificity	AgenDedAssetSpecificity	AgenProcAssetSpecificity	AgenTemporalSpecificity	AgenBrandCapExposure	AgenPropInfoExposure	BehUncerSuppUnreliability	VolUncerPredictDemand	TechUncerRapidDevelopments	TechUncerUnpredictDevelopments	ValueAssessPriceTasksEase	ContrAssessDeterSuppPerfOrEase	TransactionFrequency
1	0.00	1	5.51	2.44	0.22	0.41	0.34	4.48	4.56		0.22	2.28	4.54	2.64	2.41	2.20	2.36	2.76			6.43	4.53	4.65	
2	5.00	2	6.04	1.02	1.25	1.07	1.32	6.16	4.11	1.96	5.68	3.84	4.88	3.57	7.00	3.15	3.89	1.23	0.00	3.24	3.43		3.99	7.00
3	0.00	1	6.77	1.32	0.55	1.51	0.48	6.51	5.49	0.51	4.56	4.61	4.56	4.48	5.51		2.55	2.50	0.55	4.51	2.39	4.47	3.39	2.55
4	0.00	1	6.30	0.70	0.62	0.50	1.57	4.44	4.60	3.52	5.69	5.43	5.53	5.38	4.39	4.46	4.53	2.47	2.46	4.35	3.40	4.60	4.50	4.58
5	10.00	2	6.33	0.91	1.96	1.91	1.91	4.98	4.98	2.98	3.56	4.52	4.04	3.96	4.97	4.56	2.91	2.52	2.51	3.04	1.01	4.45	4.43	7.00
6	10.00	2	6.57	0.96	0.92	0.98	1.00	5.04	7.00	1.03	4.11		3.05	3.15			0.94	2.53	2.04	1.11	5.89	5.00	5.99	5.04
7	0.00	1	5.17	0.47	0.47	0.56	0.51	5.99	6.02	3.48	2.02	1.93	1.96	1.95	5.02	3.43	2.03	1.49	3.41	2.98	2.01	3.53	6.46	6.47
8	42.50	2	6.53	3.48	3.67	3.55	3.73	4.72	5.53	3.30	2.87	3.91	3.77	3.65	3.79	3.44	5.49	1.22	2.80	2.88	3.52	5.08	3.28	2.94
9	0.00	1	6.50	2.01	1.01	0.00	1.04	5.99	6.05	1.97	4.01	4.01	4.00	4.01	5.99	4.03	2.98	3.04	2.02	2.98	4.00	5.04	4.95	5.02
10	0.00	1	5.03	3.00	0.56	0.54	0.75	6.50	6.80	5.89	6.53	4.95	4.99	4.83	6.36	5.43	5.22	2.92	0.78	4.52	2.44	6.24	6.55	2.04
11	0.00	1	5.87	3.50	3.52	3.46	3.52	4.61	4.61	1.75	2.49	2.83	2.75	2.71	2.64	2.59	2.42	2.82	3.59	3.46	3.40	3.50	3.54	4.99
12	0.00	1	6.14	0.18	0.22	0.22	0.19	5.03	6.29										0.25	3.00	3.84	4.82		4.99
13	0.00	1	5.10	2.30		1.13	1.10	5.49	6.46	2.73	4.55	5.52	4.16	4.76	5.08	4.09	4.11	2.37	3.46	4.39	2.66	3.97		1.58
14	15.00	2	4.56	2.07	0.07	1.95	1.92	6.85	5.96	1.98	4.92	4.99	4.98	3.98	3.39	3.95	1.75	2.03	3.46	4.98	1.01	5.02	4.06	3.98
15	0.00	1	5.93	0.11	0.08	0.17	0.11	6.87	6.87	1.03	5.91	5.12	5.85	5.91	0.59	2.00	1.05	6.06	1.06	4.91	2.06	5.48	6.92	6.93
16	0.00	1	6.58		0.02	0.06	0.07	6.94	6.96										3.27	2.96	4.03	4.20		6.84
17	0.00	1	5.17	2.53	0.78	1.22	0.72	6.52	6.80	2.55	4.58	4.20	4.44	4.34	4.54	4.47	2.55	2.54	0.78	4.56	2.57	4.50	4.61	6.48
18	0.00	1	6.40					6.18	6.11		6.04								1.36	3.65	3.16	5.58		4.46
19	0.00	1	5.25	3.04	3.48	1.48	1.45	6.05	5.02	2.03	6.03	6.03	6.44	5.48	6.59	2.48	2.04	1.45	3.44	3.29	1.98	1.98	4.03	7.00
20	0.00	1	6.30	2.99	3.06	2.99	3.08	6.03	6.05	2.48	4.94	3.98	3.98	3.97	2.99	3.02	2.51	1.96	2.96	2.04	4.97	3.92	4.01	6.99
21	10.00	2	5.72						5.02		5.09	4.17	4.52	4.70	3.09	3.54		1.94	1.91					
22	0.00	1	5.31	0.00	1.45	1.42	1.47	4.99	5.05	0.00	5.05	5.05	4.98	5.07	4.07	5.00	0.00	2.07	3.00	2.00	0.97	2.96	5.95	5.50
23	0.00	1	5.34	1.47	1.98	1.42	1.42	4.98	5.00	0.73	4.57	5.05	3.94	2.52	2.80	4.61	0.56	1.61	0.04			3.00	6.02	7.00
24	0.00	1	6.16	6.99	0.00	0.00	2.18	4.04	7.00	2.52	7.00	7.00	7.00	7.00	7.00	4.75	2.86	0.00	3.30	6.35	3.42	3.69	7.00	7.00
25	10.00	2	5.81	2.87	2.74	2.86	2.85	2.76	2.78	2.72	2.92	2.86	2.95	2.86	1.92	2.12	2.67	1.15	0.55	0.97	6.11	6.37	4.61	0.54
26	50.00	2	5.10	0.84	1.03	0.95	1.03	4.54	5.89	1.44	2.09	4.98	3.98	5.05	3.94	3.95	2.77	1.97	1.27	3.57	2.75	4.14	4.42	1.09
27	0.00	1	5.15	2.03	1.03	2.01	3.01	7.00	6.99	2.01	4.00	4.96	4.00	4.06	4.96	4.98	1.00	2.02	4.98	4.02	1.98	3.00	5.97	4.00
28	25.00	2	5.68	3.08	1.00	2.59	2.48	5.03	6.99	4.11	4.03	2.14	3.06	4.03			3.04	3.95	4.99	4.02	3.95	1.96	4.95	4.01
29	0.00	1	5.59	6.00	4.52	6.59	6.62	4.96	6.84	2.50	3.97	4.99	3.96	3.99	1.92	2.54	2.46	2.03		4.53	2.02			5.55
30	0.00	1	6.24	0.08	0.03	0.08	0.05	4.87	4.91	1.00	3.99	4.80	4.51	4.53	3.87	4.67	1.03	3.03	0.04	4.90	2.73	6.94	6.96	3.03
31	0.00	1	6.13	0.86	0.56	0.31	3.57	5.89	6.08	0.35	5.54	5.49	5.04	4.63			2.61		0.87	0.19	4.60	4.65	6.38	5.58
32	0.00	1	5.30	1.35	1.02	1.21	1.09	6.96	6.96	2.95	6.49	6.29	6.47	6.31	4.85	3.25	0.98	2.07	1.61	3.41	4.56	4.05	3.49	1.94
33	0.00	1	6.70	2.36	1.04	1.04	1.34	5.93	5.84	1.03	3.05	0.79	0.91	0.89	1.04		2.72	2.48	2.93	2.98	2.08	4.14	5.95	2.84
34	0.00	1	6.16	1.09	1.11	1.05	1.06	3.01	7.00	1.01	1.03	1.04	1.07	0.98	0.99	1.03	1.07	1.97	1.03	1.06	3.99	5.95	5.95	2.62
35	0.00	1	5.46	1.95	1.94	1.94	1.94	3.96	4.96	1.83	4.98	4.96	4.99	4.99	4.99	3.82	2.88	1.01	2.97	2.99	3.05	4.06	4.57	4.96
36	0.00	1	5.55	0.02	0.00	0.00	0.00	5.92	6.06	0.02	0.00	0.00	0.00	0.00	6.06	4.03	0.00	1.92	0.02	1.34	2.08	5.97	7.00	2.44
37	0.00	1	6.99	0.18	0.15	0.21	0.21	4.59	4.45	1.97	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.38	1.12	1.08	4.48	4.92	6.70	6.96
38	0.00	1	5.32	2.89	3.63	0.97	1.04	5.40	5.95	0.79	4.38	6.21	4.85	5.51	0.74		2.65	1.41	1.00	4.03	2.03	4.06	4.95	3.45
39	0.00	1	6.14	4.81	5.12	5.28	5.89	7.00	4.62	3.26	4.57	6.97		4.63	2.56	4.47	3.52	4.38	2.66	4.68	3.27	4.35	3.39	4.70
40	0.00	1	6.72	2.26	0.96	0.90	2.74			1.64	2.04	3.97	2.52	2.89	4.38	4.37	1.12	2.59					6.30	
41	0.00	1	6.61	0.44	0.05	0.08	1.35	1.00	0.23	0.81					0.06		1.55	4.18	0.12	0.17	3.04	6.56	6.90	2.71
42	0.00	1	6.30		0.99	1.42	1.55	6.44	6.03	1.44							1.08	0.26	2.97	2.92	4.01	4.56	6.33	5.43
43	0.00	1	5.61	1.55	0.95	1.05	0.83	4.65	7.00	2.55	5.71	4.93	4.95	4.27	2.67	2.10	1.75	2.16	1.86	4.33	4.06	5.92	4.10	6.57
44	0.00	1	5.99	6.72	1.05	0.64	6.78	6.85	6.19	0.92	6.03	5.63	5.87	5.74	2.61	5.55	0.88	2.98	0.55	2.22	5.06	4.98	3.51	5.01
45	17.50	2	5.93	3.84	5.44	1.15	5.38	5.64	7.00	2.01	4.40	5.71	2.64	4.99	0.49	2.51	3.38	4.24	1.48	2.30	2.55	5.71	6.17	5.74
46	0.00	1	5.04					2.87	3.06										1.47	3.09	4.05	3.63		1.47
47	40.00	2	5.93	1.69	1.24	1.32	1.20	5.75	5.65										2.42	5.31	4.99	6.36	4.78	2.04
48	0.00	1	6.14	5.96	1.01	6.05	3.95	5.96	6.99	3.95					5.96		3.86	2.62	1.02	3.00	4.99	2.05	1.04	1.02
49	0.00	1	6.25	0.03	0.04	0.02	0.03	3.99	3.00	0.00	0.04	0.06	0.03	0.04	0.04	0.04	0.00		0.00	0.98	6.59	5.98	6.96	2.60
50	0.00	1	5.98	3.01	1.06	1.11	1.08	6.99	6.97		5.08	4.04	6.03	3.93	6.99		1.01	0.98	3.52	3.97	5.58	2.94	5.91	6.96
51	35.00	2	5.33	1.17	0.77	1.27	1.30	3.93	3.77		3.00	1.34	1.28	2.13	3.21	0.90	1.43	2.00			1.56		2.47	2.47
52	0.00	1	7.16					4.33	6.64	1.97	3.10	3.56	4.24	3.00	0.24	0.77		2.72	2.48	1.06	5.70	5.46	6.21	3.54
53	0.00	1	7.28	2.14	0.15	0.24	1.11	2.96	4.01	1.06	0.24	1.15	3.03	0.17	2.05	1.99	1.10	2.99	0.19	1.13	4.09	3.06	4.89	6.01
54	0.00	1	5.80	2.93	3.01	3.05	3.01	4.96	5.07	3.08	3.00	2.86	3.00	2.96	2.96	4.96	2.96	4.06		2.84	4.04	3.92		3.03
55	0.00	1	6.91	3.75	3.05		2.96	6.62	6.68	3.24	4.11	5.08	4.43	5.07	3.99	3.94	3.54	2.40	0.80	2.65	1.87	4.09		2.70
56	0.00	1	4.51	1.59	1.66	1.64	2.62	1.54	7.00	0.72		4.13	4.91	3.94	0.92	0.74	1.37	2.48		1.23	5.60	4.89	5.34	4.55
57	0.00	1	5.65	0.39	0.36	0.29	0.22	4.02	4.01		0.07								0.15	3.13	3.97	3.99	5.94	5.08
58	0.00	1	7.27					6.88	6.83										0.24					3.59
59	0.00	1	6.42	0.96	0.92	0.92	0.92	1.88	4.96	0.94	4.96	4.93	4.91	3.92	2.94	2.91	0.98	0.00	2.96	2.94	4.11	3.47	4.02	3.94
60	0.00	1	5.97	1.93	0.62	0.38	0.60	4.52	5.99	0.94	1.23	1.32	1.37	0.60	0.84	2.53	4.55	3.58	0.99	1.97	5.24	5.07	2.99	4.93
61	0.00	1	5.51	0.93	0.18	0.30	0.21	4.50	4.46		0.25	2.28	4.17	2.42	6.20	2.27	2.35	2.80	2.36		6.53	2.30	6.65	
62	0.00	1	6.04	0.99	1.10	0.96	1.38	6.12	6.03	1.79	5.62	4.75	4.10	3.72	7.00	2.63	3.62	0.70		3.21	3.28		3.99	7.00
63	10.00	2	6.77	1.36	1.61	1.53	1.51	6.53	5.52	0.55	2.41	2.39	2.38	2.39	4.52		2.49	2.48	3.51	4.55	4.52	3.39	3.37	
64	25.00	2	6.30	0.65	0.53	0.51	1.57	4.41	4.54	3.52	5.66	5.37	5.49	5.40	3.36	4.48	4.55	2.53	3.44	4.40	2.59	4.58	4.54	4.58
65	10.00	2	6.33	1.02	1.85	1.90	1.91	5.01	7.00	2.95	3.56	4.53	3.94	3.97	4.94	4.50	2.92	2.52	2.52	3.03	1.01	4.48	4.43	7.00
66	10.00	2	6.57	0.99	1.00	0.92	0.99	6.09	6.99	3.01	5.02		4.06	3.94			2.94	2.46	2.52	1.08	4.99	4.03	4.78	6.33
67	5.00	2	5.17	0.44	0.48	0.54	0.51	6.03	6.02	4.07	1.99	1.95	1.96	1.96	5.00	3.38	2.00	1.50	3.41	2.95	2.02	3.02	6.50	5.57
68	100.00	2	6.53	3.27	3.90	3.17	3.60	5.08	5.29	2.84	3.28	4.09	3.55	3.70	4.04	3.83	4.84	2.65	2.87	3.79	4.26	3.00	3.21	3.97
69	0.00	1	6.50	2.02	1.01	0.00	1.04	5.97	6.06	1.95	4.00	4.03	4.00	4.01	5.98	4.03	2.98	3.02	4.06	2.99	4.00	4.99	4.95	6.00
70	0.00	1	5.03	2.91	0.69	0.56	0.73	5.18	6.68	6.15	6.24	4.95	4.75	4.64	6.21	5.43	5.27	2.75	1.33	4.33	2.25	4.93	6.50	2.01
71	30.00	2	5.87	3.52	3.52	3.43	3.50	4.61	4.61	1.63	2.52	2.70	2.70	2.75	2.68	2.55	2.42	2.86	3.59	3.45	3.40	3.51	3.56	5.01
72	10.00	2	6.14	0.18	0.21	0.19	0.19	6.06	6.34	0.51	3.99	5.00	4.06	4.06	6.63	5.08	2.19	2.97	1.99	4.13	3.84	4.23	4.93	4.99
73	0.00	1	5.10	2.29		1.13	1.09	6.37	6.46	2.76	4.54	5.57	4.54	4.82	5.65	4.09	4.12	2.41	3.13	4.61	3.50	3.25		
74	80.00	2	4.56	1.41	0.09	1.95	1.83	6.80	5.03	1.98	3.63	4.96	4.92	4.96	3.42	3.93	1.73	0.85	5.65	3.99	3.03	3.00	3.50	6.97
75	20.00	2	5.93	0.11	0.08	0.19	0.08	2.96	6.85	1.97	3.74	5.10	4.96	4.50	4.95	3.96	4.96	4.11	3.99	1.96	2.07	1.08	6.92	3.99
76	20.00	2	6.58		0.03	0.04	0.06	6.84	6.99										3.28	2.94	4.03	4.16		4.95
77	40.00	2	5.17	2.42	0.66	1.20	0.88	6.38	6.74	2.76	4.38	4.28	4.38	4.25	4.54	4.54	2.44	2.75	2.45	3.48	2.73	3.43	4.64	5.47
78	0.00	1	6.40					6.06	5.97				5.12						1.39	3.73	3.27	2.87		6.48
79	0.00	1	5.25	3.02	1.42	1.47	1.45	5.00	6.03	1.47	6.03	6.02	6.46	5.48	6.62	1.03	1.48	1.12	3.44	3.27	2.01	1.98	5.54	7.00
80	5.00	2	6.30	2.99	3.05	2.99	3.05	6.03	6.03	2.50	4.98	3.93	3.97	3.93	3.94	3.05	2.54	1.97	3.59	2.04	4.95	3.02	4.01	6.99
81	40.00	2	5.72					5.11	6.60		6.44	5.59	5.09	5.52	5.39	5.42		1.79	4.68	3.16		3.10		
82	0.00	1	5.31	1.03	1.47	1.42	1.47	7.00	6.15	0.00	5.05	5.07	4.98	5.05	4.07	5.00	0.00	2.12	5.99	1.39	2.94	5.55	5.96	4.00
83	7.50	2	5.34	1.45	1.98	1.42	1.37	4.99	5.02	0.73	4.58	4.95	4.01	2.56	2.83	4.62	0.56	2.98	3.27			3.57	6.00	3.95
84	35.00	2	6.16	2.15	0.00	0.00	0.64	7.00	6.15	1.64	7.00	7.00	7.00	7.00	7.00	4.75	4.64	1.71	6.37	3.55	4.56	0.95	5.67	4.49
85	0.00	1	5.81	2.76	2.94	2.89	2.78	2.91	2.86	2.88	3.06	2.87	2.94	2.76	1.97	1.97	2.96	1.24	0.63	0.86	6.13	5.94	4.61	0.37
86	65.00	2	5.10	0.88	0.98	0.92	1.01	4.59	6.34	1.00	2.04	4.96	3.98	5.04	3.97	3.95	2.77	2.02	2.89	4.87	2.37	2.09	4.45	4.56
87	10.00	2	5.15	2.95	1.98	3.01	2.91	6.00	6.00	2.96	5.02	4.09	4.92	4.98	6.05	4.95	2.01	1.04	4.98	4.01	3.00	2.04	4.96	5.01
88	10.00	2	5.68	3.03	1.01	2.58	2.48	5.02	6.99	4.09	3.94	2.11	2.97	4.03			2.95	3.92	4.98	4.02	4.00	2.05	4.95	7.00
89	0.00	1	5.59	4.49	6.54	6.60	6.63	6.56	6.90	4.00	3.93	4.96	3.97	4.00	2.42	4.53	3.60	3.00	2.54	4.52	3.06	4.03	5.04	2.51
90	20.00	2	6.24	0.12	0.01	0.04	0.06	4.91	4.90	0.99	3.94	4.81	4.60	4.47	3.90	4.76	1.04	3.03	2.00	4.53	2.68	2.96	5.94	1.01
91	50.00	2	6.13	0.52	0.58	0.28		6.69	6.53	0.34	5.59	5.57	4.99	4.62			2.64	6.28	4.62	0.22	4.59	3.01	6.39	1.50
92	50.00	2	5.30	2.54	1.02	2.21	1.09	6.91	6.96	2.98	6.49	6.38	6.56	6.40	4.91	3.24	0.98	2.05	3.95	3.41	4.56	2.08	2.44	3.90
93	5.00	2	6.70	2.32	1.01	1.07	1.23	5.96	5.99	0.94	2.05	0.78	1.13	0.82	0.97		2.67	2.59	6.87	4.99	4.06	2.05	3.46	6.82
94	10.00	2	6.16	1.05	1.09	1.00	1.08	7.00	7.00	1.04	5.02	5.03	3.04	1.97	4.03	1.00	2.00	1.97	3.06	1.06	3.98	4.44	5.97	5.04
95	50.00	2	5.46	1.95	1.94	1.89	1.91	4.99	4.92	1.79	4.98	4.95	4.94	4.89	4.93	3.70	2.80	1.08	3.95	2.96	3.07	4.07	4.64	4.96
96	7.50	2	5.55	0.00	0.00	0.00	0.00	5.94	6.06	6.14	6.07	6.03	6.04	6.10	6.07	4.03	2.19	1.95	0.03	1.33	2.07	6.00	6.01	3.11
97	0.00	1	6.99	0.19	0.15	0.21	0.19	5.35	4.45	1.98	0.00	0.00	0.00	0.00	0.00	0.00	1.94	2.42	3.04	1.73	4.48	4.95	6.70	6.96
98	5.00	2	5.32	2.74	1.98	0.94	1.16	6.21	6.00	0.66	6.04	6.24	5.93	5.57	0.77		2.47	1.34	2.19	5.08	3.91	2.02	3.24	1.54
99	0.00	1	6.14	1.10	0.99	1.26	0.87	4.14	2.77	3.42	6.26	3.27		3.43	5.96	4.87	3.52	2.43	3.20	1.38	3.24	0.62	1.36	1.56
100	10.00	2	6.72	1.55	0.99	0.25	2.75			1.69	2.04	4.46	2.56	3.06	4.48	4.37	1.13	2.58					2.93	
101	5.00	2	6.61	2.10	0.05	0.03	0.44	2.47	0.18	0.83					0.05		1.60	4.27	0.17	0.17	3.06	6.65	6.90	1.32
102	7.50	2	6.30	3.04	0.96		1.51	6.41	6.40	2.47							2.36	3.32	4.67	5.15	4.01	2.48	4.02	4.70
103	40.00	2	5.61	1.51	0.77	0.95	1.17	6.87	7.00	3.57	5.42	3.60	3.45	4.18	7.00	2.45	1.91	1.72	3.63	2.76	5.83	2.26	6.60	4.67
104	5.00	2	5.99	6.72	6.84	0.72	6.79	6.88	6.17	0.92	3.66	3.56	4.75	6.02	2.63	5.55	0.85	1.55	6.48	2.23	4.69	4.46	2.44	3.99
105	12.50	2	5.93	4.46	4.77	0.98	2.90	4.67	7.00	2.28	6.13	5.94	2.94	5.58	0.44	2.50	3.59	4.11		2.04	3.35	6.26	6.51	3.92
106	15.00	2	5.04					4.74	3.05										1.47	2.80	4.05	3.67		1.44
107	10.00	2	5.93	1.82	1.24	1.22	1.22	6.08	5.40										2.79	4.70	5.93	4.28	4.78	3.99
108	25.00	2	6.14	5.95	1.01	5.96	3.93	5.90	6.09	3.95					6.91	5.93	3.92	2.65	1.01	2.97	2.99	2.06	1.07	0.99
109	15.00	2	6.25	0.19	0.06	0.04	0.22	6.32	4.42	0.00	0.04	0.06	0.02	0.06	0.09	0.04	0.00		4.37	0.59	6.59	4.15	6.94	4.65
110	35.00	2	5.98	2.02	1.05	1.09	1.08	6.97	6.96		5.97	4.04	6.00	3.95	6.96		1.02	1.05	6.08	2.04	5.58	0.87	5.91	4.14
111	25.00	2	5.33	1.31	0.78	1.15	3.13	7.00	4.25		3.13	1.35	1.37	2.28	4.62	0.93	1.32	2.10			1.57		2.52	3.26
112	12.50	2	7.16					5.48	6.66	2.05	2.96	6.61	6.21	3.10	0.24	0.70		2.72	2.53	2.33	4.72	5.56	6.21	3.56
113	10.00	2	7.28	4.11	0.14	0.24	1.08	3.94	3.99	1.06	0.24	1.11	3.00	0.17	3.00	2.00	1.10	3.01	1.06	1.18	4.04	3.06	4.98	5.97
114	25.00	2	5.80	2.88	3.03	3.01	3.00	4.95	5.03	2.98	5.13	2.98	3.06	2.96	2.96	5.00	2.96	4.12	3.05	2.36	4.09	4.02		3.97
115	10.00	2	6.91	3.63	3.05		3.03	6.56	6.71	3.17	4.02	5.07	4.40	5.03	3.95	4.04	3.56	2.48	2.47	2.52		4.16	4.50	0.79

B.2 Variable distributions, normality, transformations and outliers (both datasets)

B.2.1 Efficiency-based variable data screening

Principal's Asset Specificity

With regard to the principals' human asset specificity variables, the associated original histograms (Figure B-1) reveal the presence of positive skewness in both datasets. Visual inspections detect a significant deviation from normality; an assessment concurred by both the Kolmogorov-Smirnov (K-S) and Shapiro-Wilk (S-W) test statistics (found to be significant at the .001 level) (Table B-1). The initial assessment did not detect any outliers or extreme values. Given the presence of positive skewness, square root transformations are applied to the variables. Figure B-2 presents the variables' distributions after the relevant transformations.

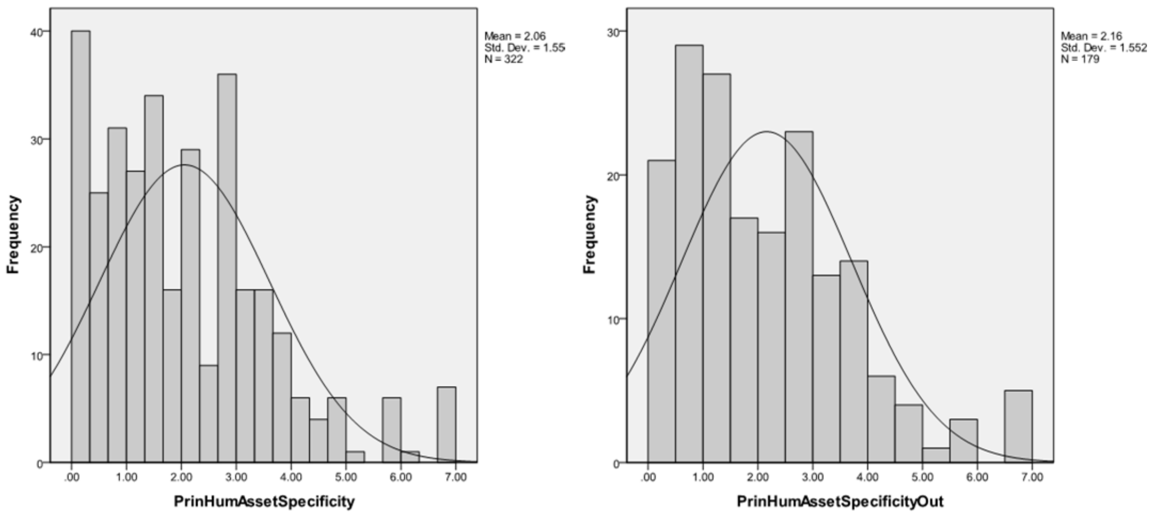


Figure B-1. Principals' human asset specificity variable original histograms (left: 360 case dataset; right: 195 case dataset)

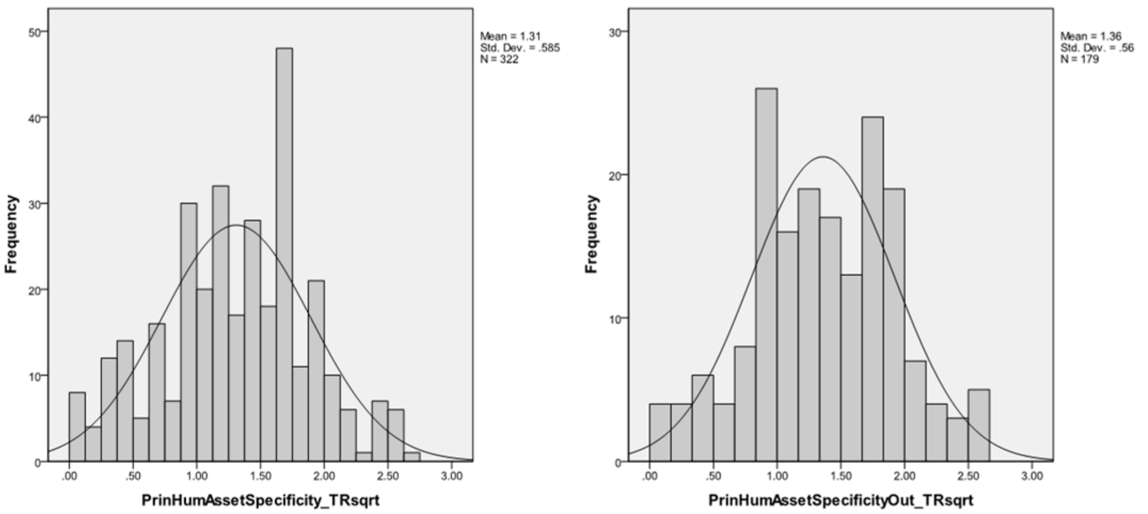


Figure B-2. Principals' human asset specificity variable histograms after transformations (left: 360 case dataset; right: 195 case dataset)

Table B-1. Statistical assessment of normality - Principals' human asset specificity

	Original distributions		Transformed distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.000	.014	.035
Shapiro Wilk statistic (sig.)	.000	.000	.006	.082

A reiterative visual inspection of the newly formed histograms argues for acceptable levels of normality in the transformed variables. The proposition is supported by improvements in both the K-S and S-W tests, with the S-W statistic found to be non-significant at the .05 level in the 195 dataset.

With regard to the principals' physical asset specificity variables, the associated original histograms (Figure B-3) reveal the presence of severe positive skewness in both datasets. Visual inspections detect significant deviations from normality; an assessment concurred by both the K-S and S-W tests (found to be significant at the .001 level) (Table B-2). The initial assessment did not detect any outliers. Given the presence of positive skewness, square root transformations are applied to the variables. Figure B-4 presents the variables' distributions after the relevant transformations.

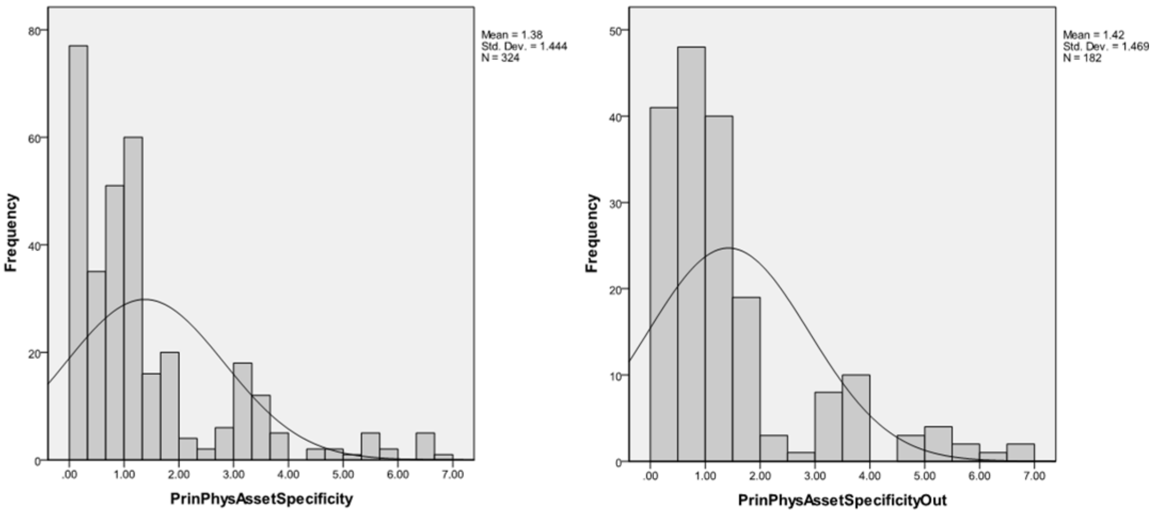


Figure B-3. Principals' physical asset specificity variable original histograms (left: 360 case dataset; right: 195 case dataset)

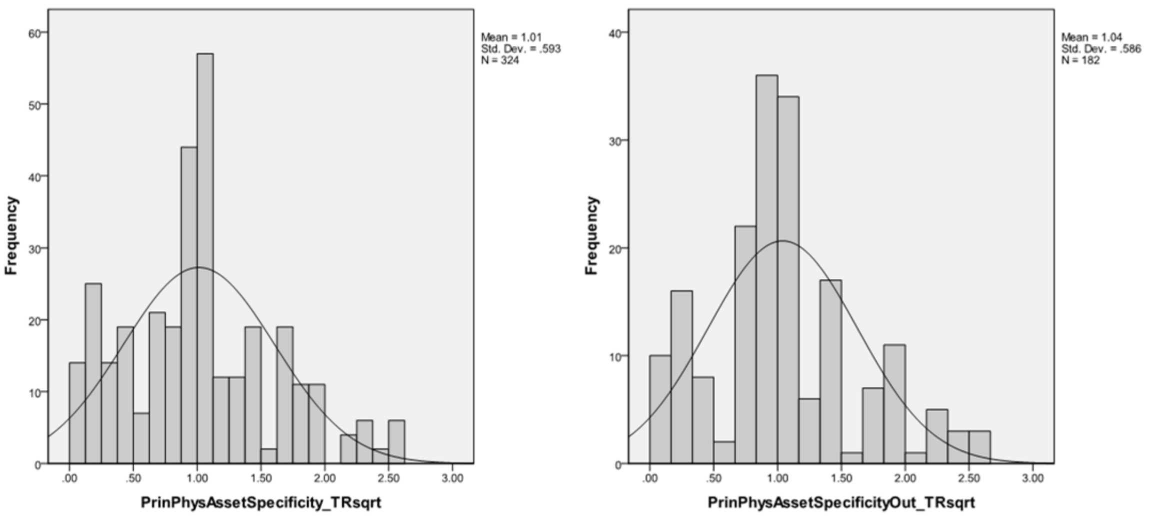


Figure B-4. Principals' physical asset specificity variable histograms after transformations (left: 360 case dataset; right: 195 case dataset)

Table B-2. Statistical assessment of normality - Principals' physical asset specificity

	Original distributions		Transformed distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.000	.000	.000
Shapiro Wilk statistic (sig.)	.000	.000	.000	.000

A reiterative visual inspection of the newly formed histograms still recognizes some deviation from normality (principally in the form of positive kurtosis); an assessment further evidenced by the the K-S and S-W tests, which still remain significant at the .001 level.

With regard to the principals' dedicated asset specificity variables, the associated original histograms (Figure B-5) again reveal the presence of positive skewness in both datasets. Visual inspections detect a significant deviation from normality; an assessment concurred by both the K-S and S-W test statistics (found to be significant at the .001 level) (Table B-3). The initial assessment did not detect any outliers or extreme values. Given the presence of positive skewness, square root transformations are applied to the variables. Figure B-6 presents the variables' distributions after the relevant transformations.

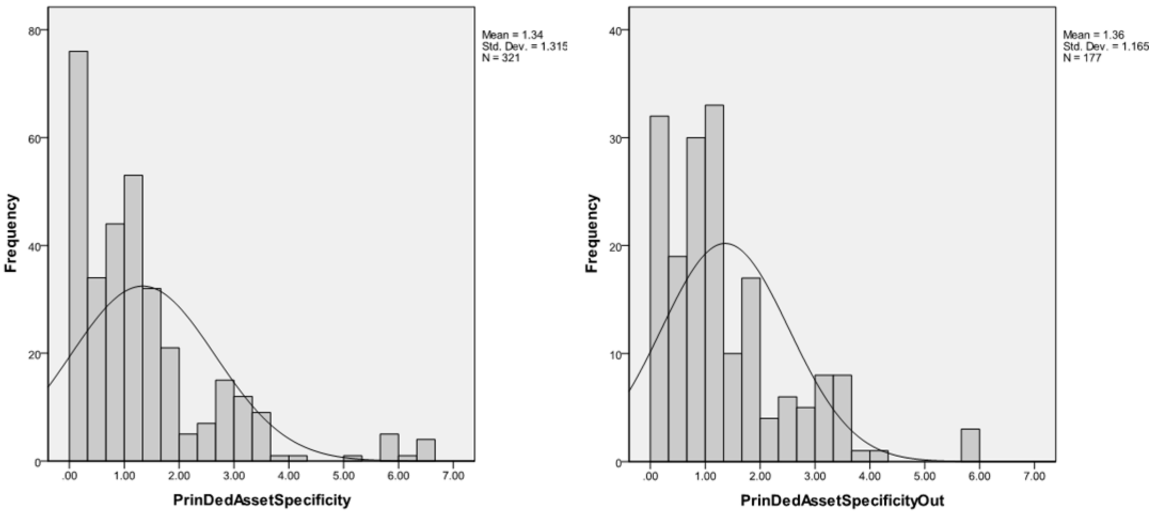


Figure B-5. Principals' dedicated asset specificity variable original histograms (left: 360 case dataset; right: 195 case dataset)

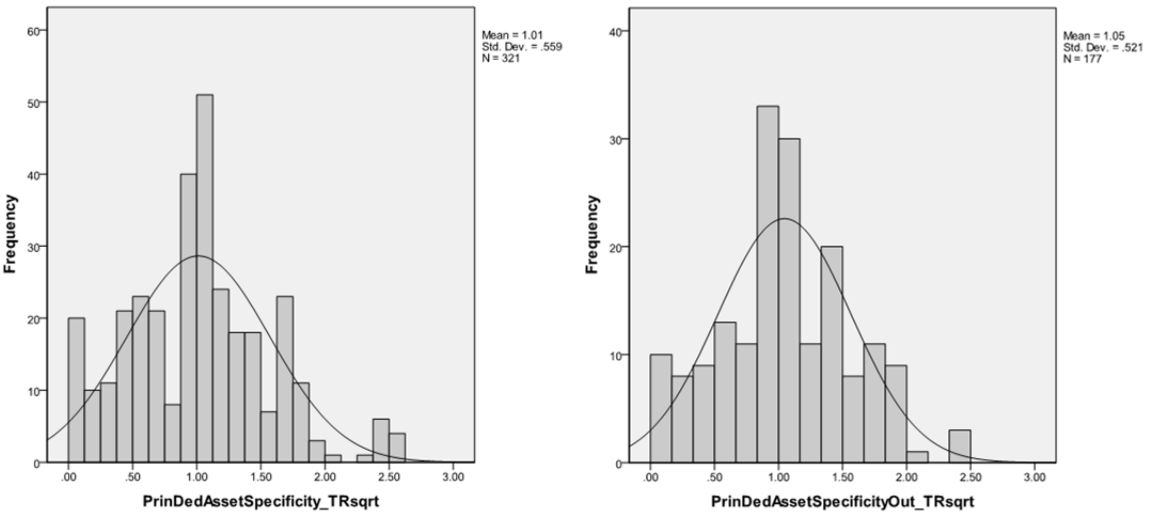


Figure B-6. Principals' dedicated asset specificity variable histograms after transformations (left: 360 case dataset; right: 195 case dataset)

Table B-3. Statistical assessment of normality - Principals' dedicated asset specificity

	Original distributions		Transformed distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.000	.000	.000
Shapiro Wilk statistic (sig.)	.000	.000	.000	.008

A reiterative visual inspection of the newly formed histograms still recognizes elements of positive kurtosis and subsequent deviations from normality; an assessment further evidenced by the the K-S and S-W tests, which still remain significant at the .001 level (with the exception of the Shapiro-Wilk statistic that is now significant at the .01 level).

With regard to the principals' procedural asset specificity variables, the associated original histograms (Figure B-7) similarly reveal the presence of positive skewness in both datasets. Initial visual inspections detect a significant deviation from normality; an assessment concurred by both the K-S and S-W test statistics (found to be significant at the .001 level) (Table B-4). The initial assessment detected only one high outlier in the 195 case dataset. Given the presence of positive skewness, square root transformations are applied to the variables. Figure B-8 presents the variables' distributions after the relevant transformations.

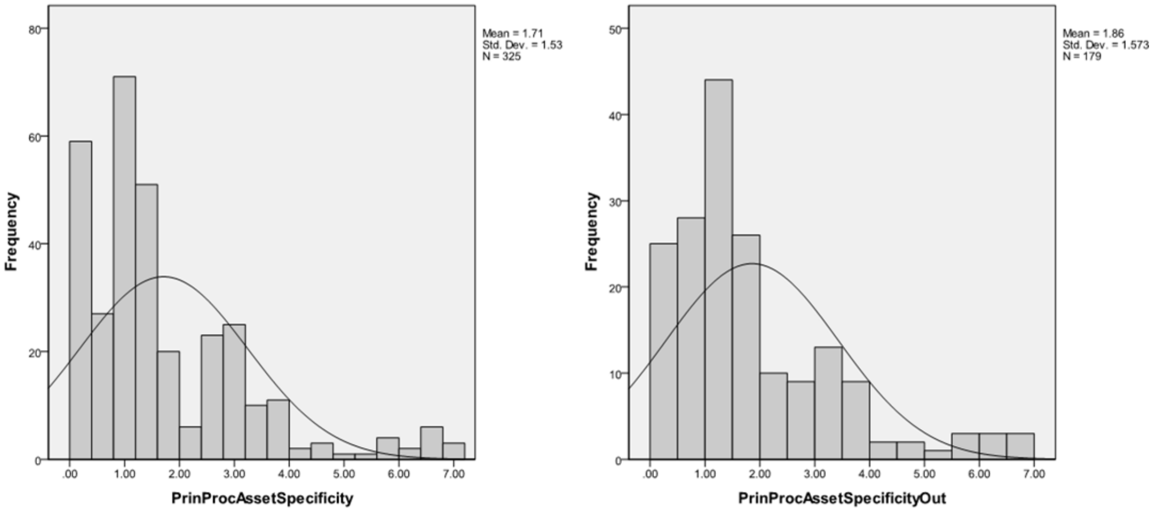


Figure B-7. Principals' procedural asset specificity variable original histograms (left: 360 case dataset; right: 195 case dataset)

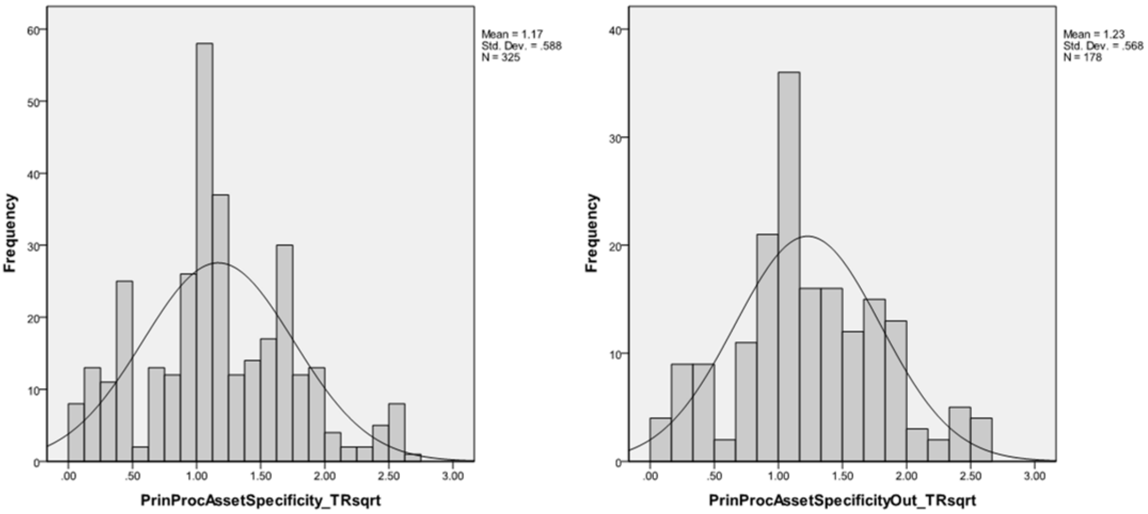


Figure B-8. Principals' procedural asset specificity variable histograms after transformations (left: 360 case dataset; right: 195 case dataset)

Table B-4. Statistical assessment of normality - Principals' procedural asset specificity

	Original distributions		Transformed distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.000	.000	.007
Shapiro Wilk statistic (sig.)	.000	.000	.000	.009

A reiterative visual inspection of the newly formed histograms still recognizes elements of positive kurtosis and subsequent deviations from normality; an assessment principally supported by the K-S test (significant at the .001 level) and to a lesser degree by the S-W test, which demonstrates improvement by now being significant at the .01 level in both datasets.

With regard to the principals' temporal asset specificity variables, the associated original histograms (Figure B-9) reveal the presence of negative skewness in both datasets. Initial visual inspections detect a significant deviation from normality; an assessment concurred by both the K-S and S-W test statistics (found to be significant at the .001 level) (Table B-5). The initial assessment did not detect the presence of any outliers or extreme values. Given the presence of negative skewness, the variables were first reflected and then transformed through square root calculations. Figure B-10 presents the variables' distributions after the relevant transformations.

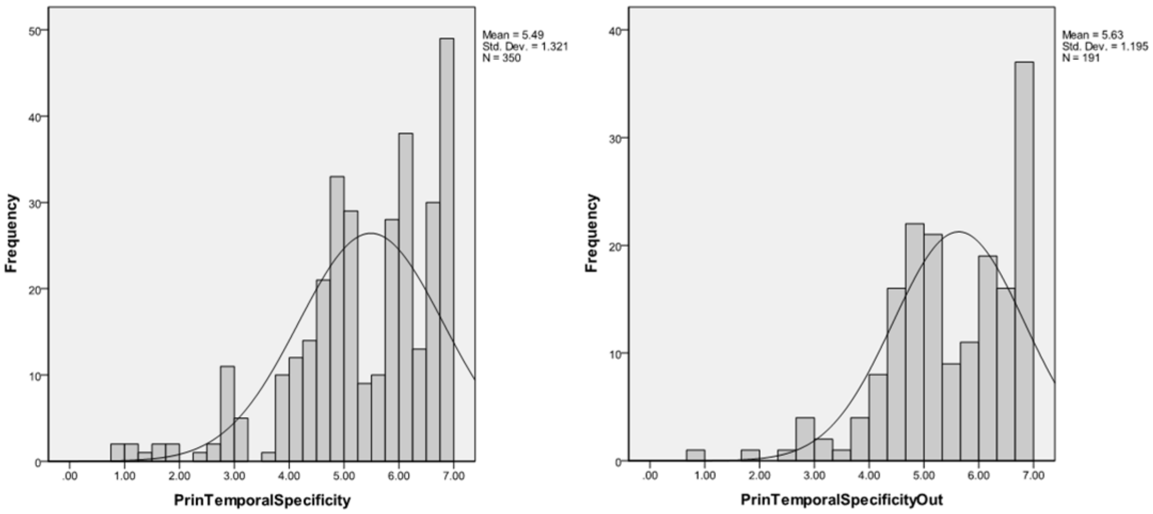


Figure B-9. Principals' temporal asset specificity variable original histograms (left: 360 case dataset; right: 195 case dataset)

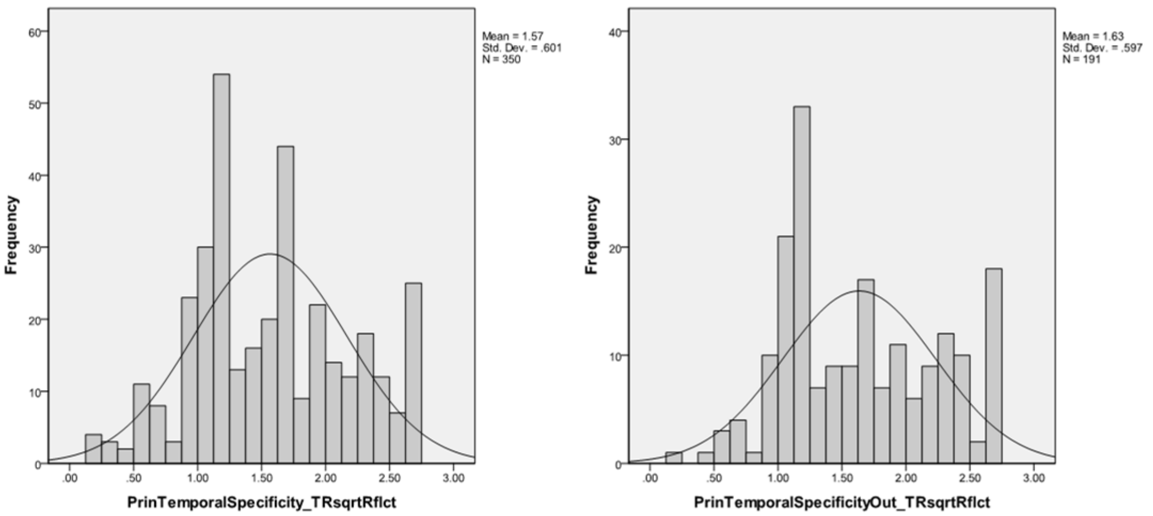


Figure B-10. Principals' temporal asset specificity variable histograms after transformations (left: 360 case dataset; right: 195 case dataset)

Table B-5. Statistical assessment of normality - Principals' temporal asset specificity

	Original distributions		Transformed distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.000	.000	.000
Shapiro Wilk statistic (sig.)	.000	.000	.000	.000

A reiterative visual inspection recognizes a significant improvement in the variables' deviation from normality though the same assertion is not supported by the relevant statistical estimates. Both the K-S and S-W tests remain significant at the .001 level even after the transformations.

Principal's Proprietary Asset Exposure

With regard to the principals' brand name capital exposure variables, the associated original histograms (Figure B-11) reveal the presence of negative skewness in both datasets. Initial visual inspections detect a significant deviation from normality; an assessment concurred by both the K-S and S-W test statistics (found to be significant at the .001 level) (Table B-6). The initial assessment did not detect the presence of any outliers or extreme values. Given the presence of negative skewness, the variables were first reflected and then transformed through square root calculations. Figure B-12 presents the variables' distributions after the relevant transformations.

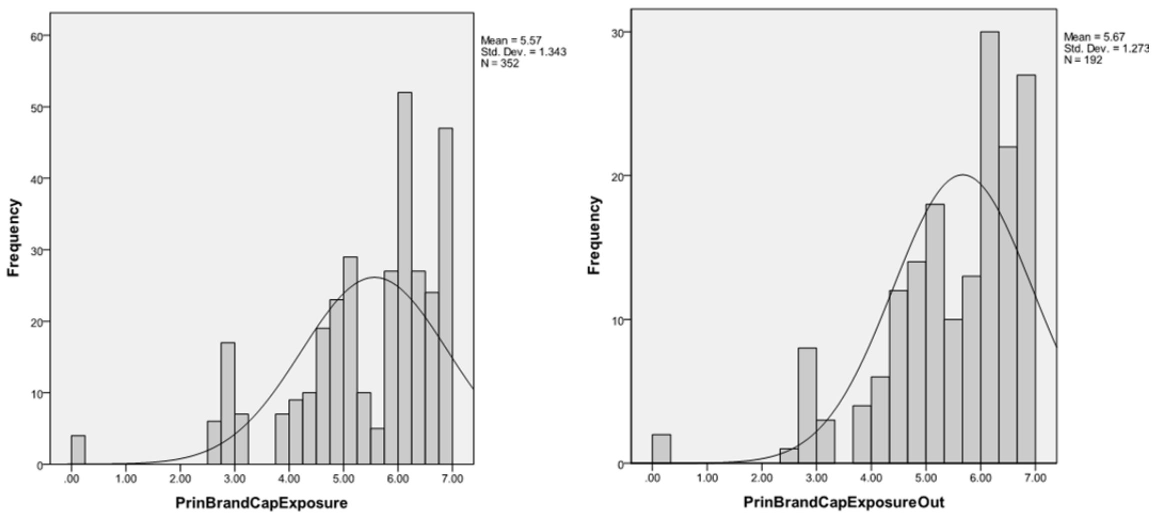


Figure B-11. Principals' brand name capital exposure variable original histograms (left: 360 case dataset; right: 195 case dataset)

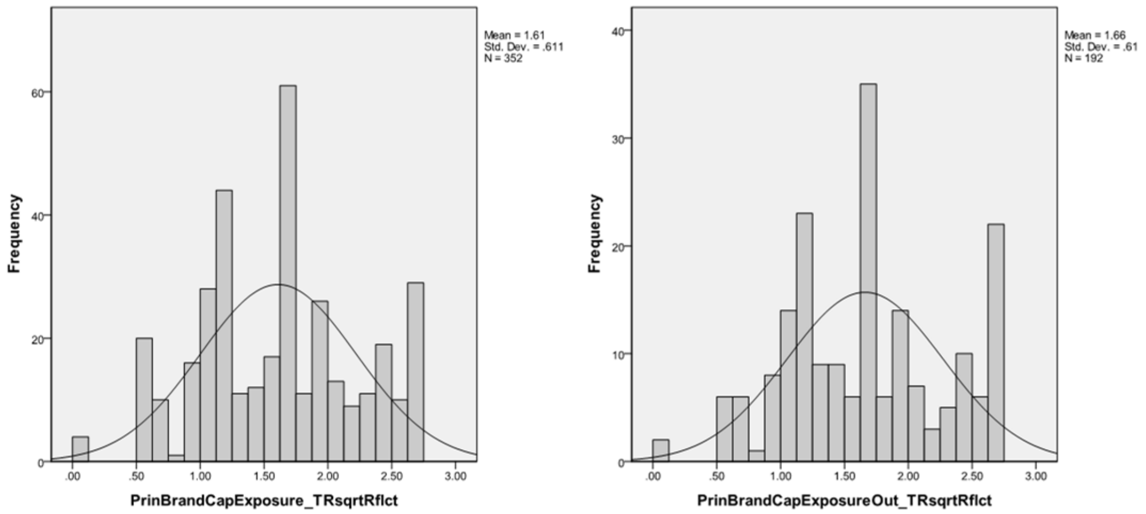


Figure B-12. Principals' brand name capital exposure variable histograms after transformations (left: 360 case dataset; right: 195 case dataset)

Table B-6. Statistical assessment of normality - Principals' brand name capital exposure

	Original distributions		Transformed distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.000	.000	.005
Shapiro Wilk statistic (sig.)	.000	.000	.000	.000

A reiterative visual inspection recognizes significant improvements in the variables' deviation from normality though the same assertion is not supported by the relevant statistical estimates. Both the K-S and S-W tests remain significant at the .001 level in the 360 case dataset while a minor improvement in the Shapiro-Wilk statistic is detected for the 195 case dataset.

With regard to the principals' proprietary information exposure variables, the associated original histograms (Figure B-13) reveal the presence of some positive skewness in both datasets. Initial visual inspections detect deviation from normality; an assessment concurred by both the K-S and S-W test statistics (found to be significant at the .001 level) (Table B-7). The initial assessment did not detect the presence of any outliers or extreme values. Given the presence of positive skewness, square root transformations are applied to the variables. Figure B-14 presents the variables' distributions after the relevant transformations.

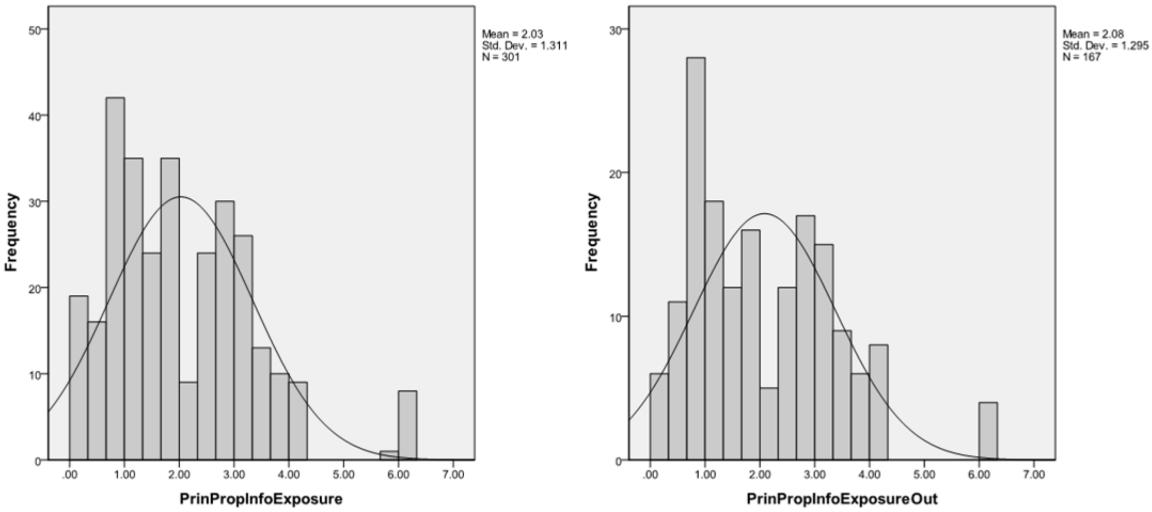


Figure B-13. Principals' propr. information exposure variable original histograms (left: 360 case dataset; right: 195 case dataset)

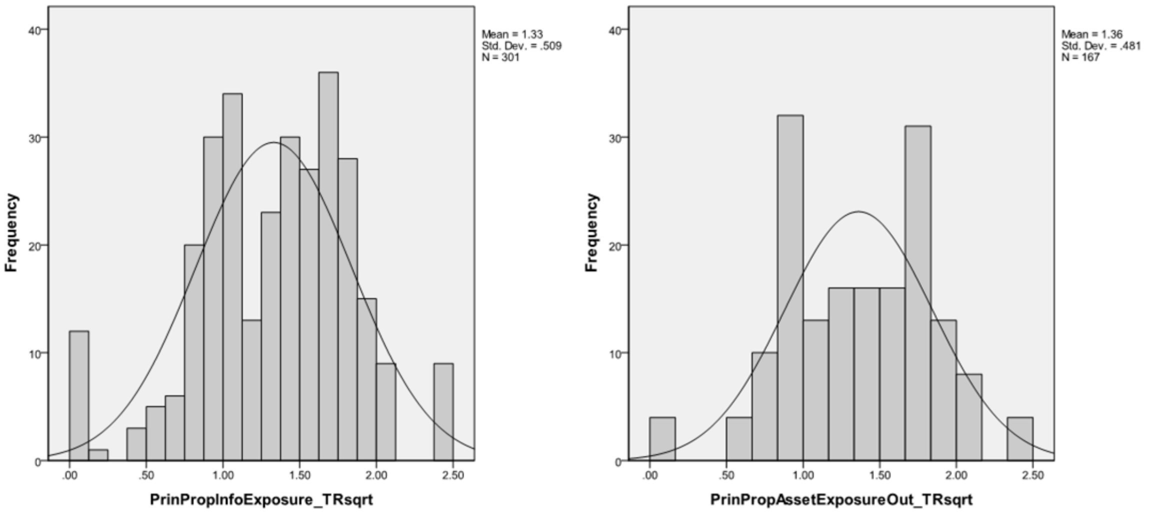


Figure B-14. Principals' propr. information exposure variable histograms after transformations (left: 360 case dataset; right: 195 case dataset)

Table B-7. Statistical assessment of normality - Principals' proprietary information exposure

	Original distributions		Transformed distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.000	.003	.000
Shapiro Wilk statistic (sig.)	.000	.000	.000	.001

A reiterative visual inspection recognizes improvement in the variables' deviation from normality; an assessment partly supported by the improved significance levels of the K-S and S-W tests. The K-S statistic is now significant at the .01 level in the 360 case dataset while the S-W statistic shows the same significance level in the 195 case dataset.

Agents' Asset Specificity

With regard to the agents' human asset specificity variables, the associated original histograms (Figure B-15) reveal the presence of reasonably normal distributions in both datasets. Visual inspections do not detect significant deviations from normality (bar the unusually high frequency detected in the '0' levels of the 360 case dataset). The assessment is concurred partially by both the K-S and S-W test statistics for the 195 case dataset (found to be significant only at the .05 and .01 levels respectively) (Table B-8). The initial assessment detected 5 low outliers in both datasets. Given the absence of skewness, no transformations are applied to the variables. Figure B-16 presents the variables' distributions after the removal of outliers.

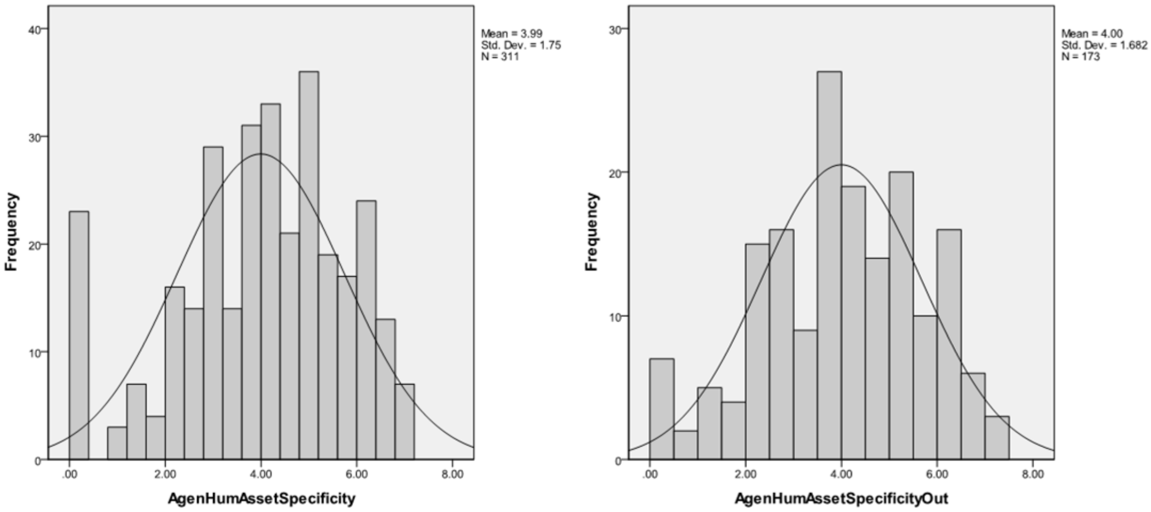


Figure B-15. Agents' human asset specificity variable original histograms (left: 360 case dataset; right: 195 case dataset)

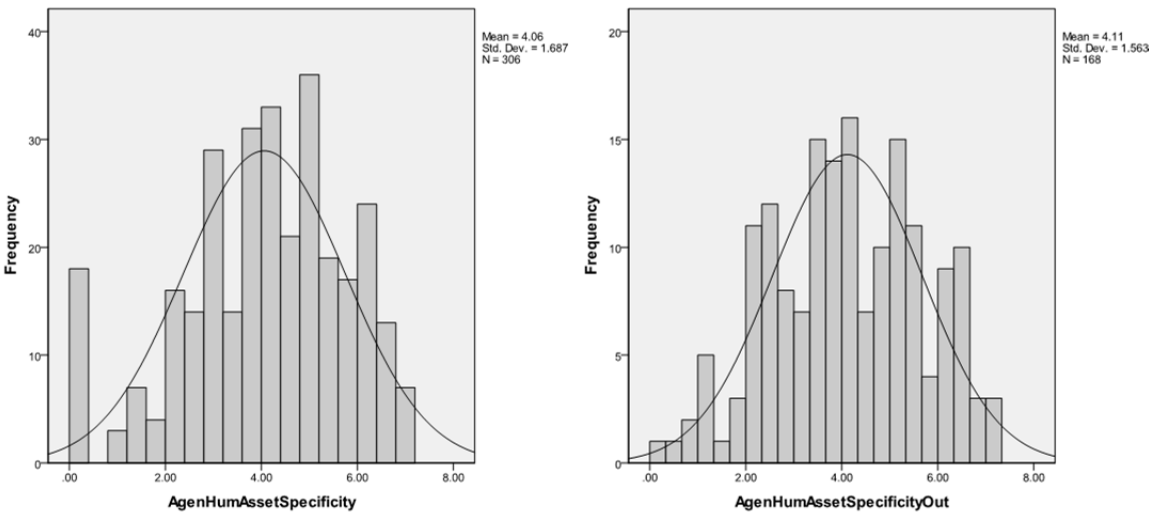


Figure B-16. Agents' human asset specificity variable histograms after outlier removal (left: 360 case dataset; right: 195 case dataset)

A reiterative visual inspection of the newly formed histograms argues for acceptable levels of normality in both datasets. The proposition is supported by improvements in both the K-S and S-

W tests for the 195 case dataset, with the Shapiro-Wilk statistic now found to be significant only at the .05 level.

Table B-8. Statistical assessment of normality - Agents' human asset specificity

	Original distributions		Pruned distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.022	.000	.028
Shapiro Wilk statistic (sig.)	.000	.007	.000	.026

With regard to the agents' physical asset specificity variables, the associated original histograms (Figure B-17) reveal the presence of a reasonably normal distribution in the 195 case dataset and a more unusual frequency dispersion in the 360 case dataset. Visual inspections do not detect a significant deviation from normality in the 195 case dataset while such a deviation is observed in the 360 case dataset (characterized by a high frequency concentration around the 'quite' significant levels of this type of specificity). The assessment is concurred by both the K-S and S-W test statistics for the 360 case dataset (both found to be significant at the .001 level) (Table B-9). The initial assessment detected 5 low outliers in both datasets. Given the absence of significant skewness, no transformations are applied to the variables. Figure B-18 presents the variables' distributions after the removal of outliers.

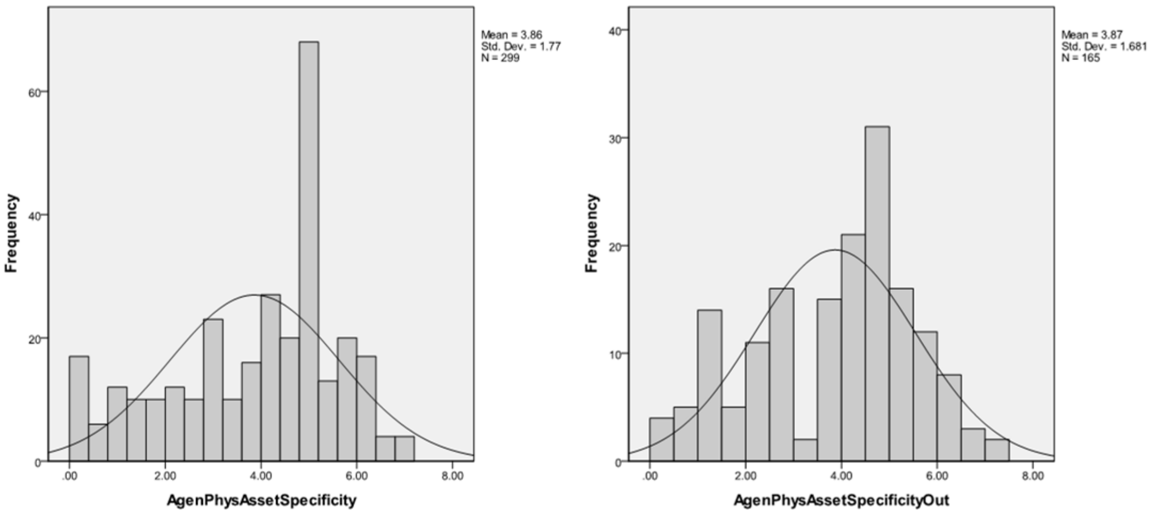


Figure B-17. Agents' physical asset specificity variable original histograms (left: 360 case dataset; right: 195 case dataset)

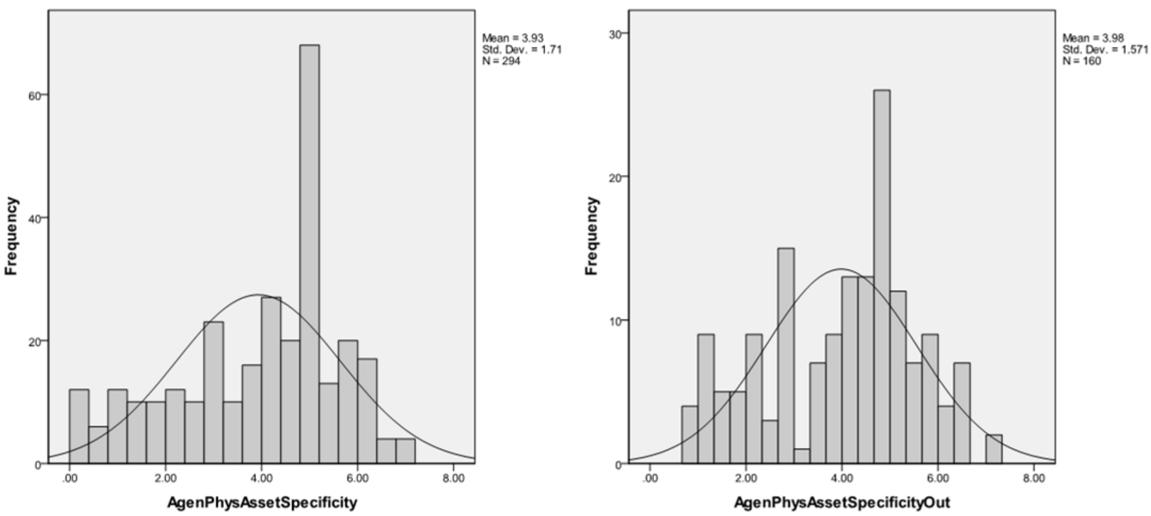


Figure B-18. Agents' physical asset specificity variable histograms after outlier removal (left: 360 case dataset; right: 195 case dataset)

A reiterative visual inspection argues for acceptable levels of normality in both datasets (given that no further manipulations are available). The proposition, however, is not supported by the K-S and S-W tests as they are both still significant at the .001 level.

Table B-9. Statistical assessment of normality - Agents' physical asset specificity

	Original distributions		Pruned distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.000	.000	.000
Shapiro Wilk statistic (sig.)	.000	.000	.000	.000

With regard to the agents' dedicated asset specificity variables, the associated original histograms (Figure B-19) do not reveal the presence of particular skewness characteristics but only some elements of kurtosis observed in both datasets. Visual inspections do not detect significant deviations from normality in the 195 case dataset; an assessment partially concurred by S-W test statistic (found to be significant at the .01 level (Table B-10). Violations of normality are, nonetheless, observed in the 360 case dataset. The initial assessment detected 5 low outliers in both datasets. Given the absence of a particular type of skewness, no transformations are applied to the variables. Figure B-20 presents the variables' distributions after the removal of outliers.

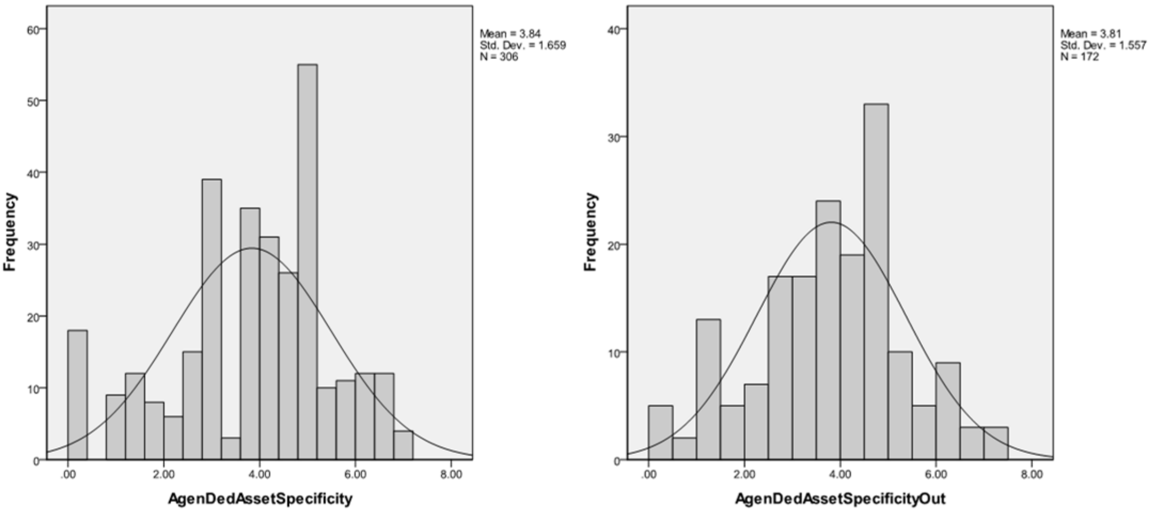


Figure B-19. Agents' dedicated asset specificity variable original histograms (left: 360 case dataset; right: 195 case dataset)

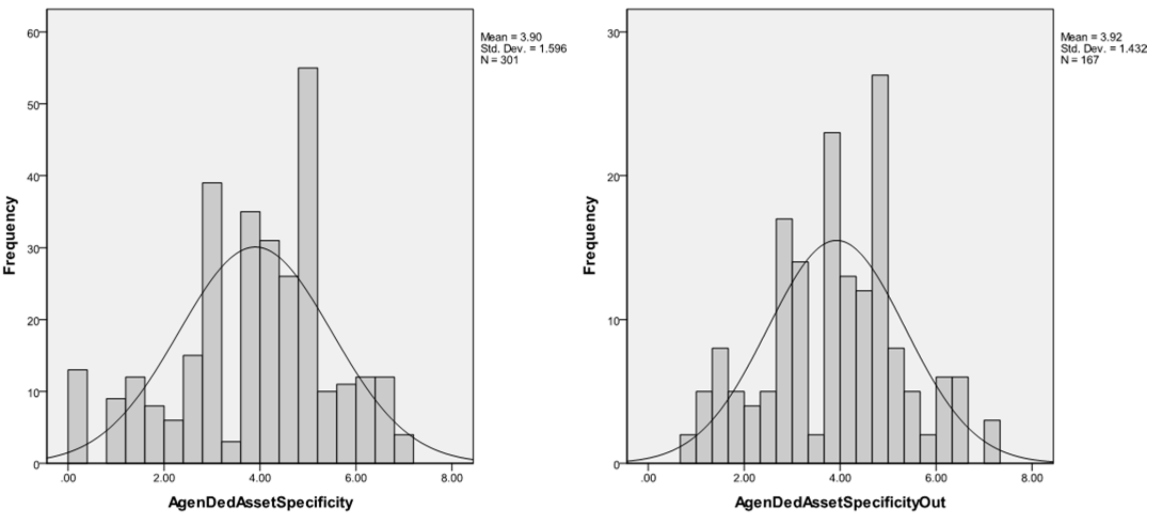


Figure B-20. Agents' dedicated asset specificity variable histograms after outlier removal (left: 360 case dataset; right: 195 case dataset)

Table B-10. Statistical assessment of normality - Agents' dedicated asset specificity

	Original distributions		Pruned distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.000	.000	.000
Shapiro Wilk statistic (sig.)	.000	.003	.000	.005

A reiterative visual inspection of the newly formed histograms argues for acceptable levels of normality in both datasets. The proposition is supported by an improvement only in the Shapiro-Wilk test for the 195 case dataset.

With regard to agents' procedural asset specificity, the associated original histograms (Figure B-21) exhibit some positive kurtosis with limited skewness in both datasets. Visual inspections do not detect significant deviations from normality. The assessment, however, is not supported by either the K-S or S-W test statistics (found to be significant at the .001 level in both datasets) (Table B-11). The initial assessment detected 5 low outliers in both datasets. Given the absence of any particular type of skewness, no transformations are applied to the variables. Figure B-22 presents the variables' distributions after the removal of outliers.

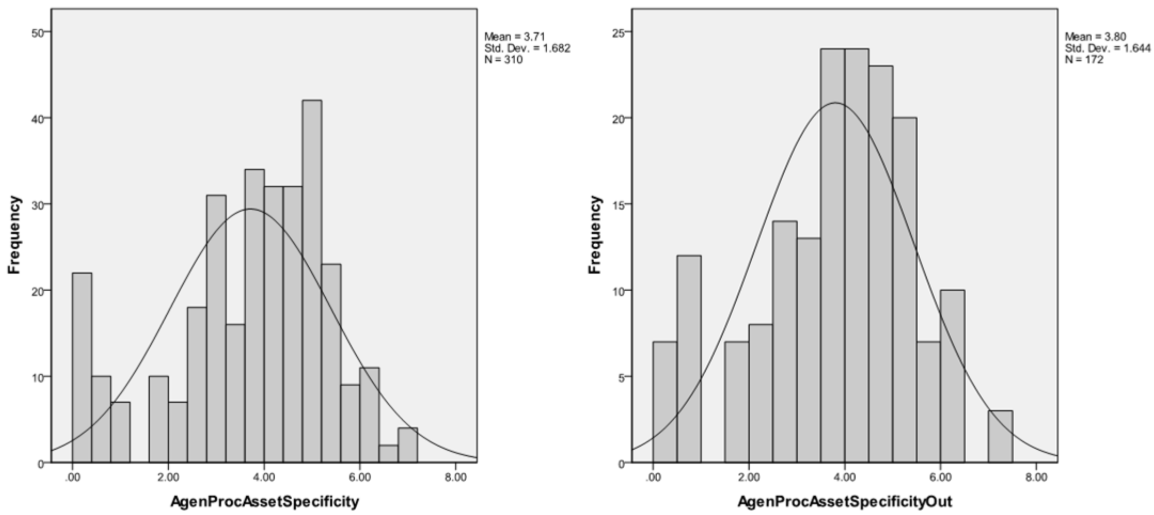


Figure B-21. Agents' procedural asset specificity variable original histograms (left: 360 case dataset; right: 195 case dataset)

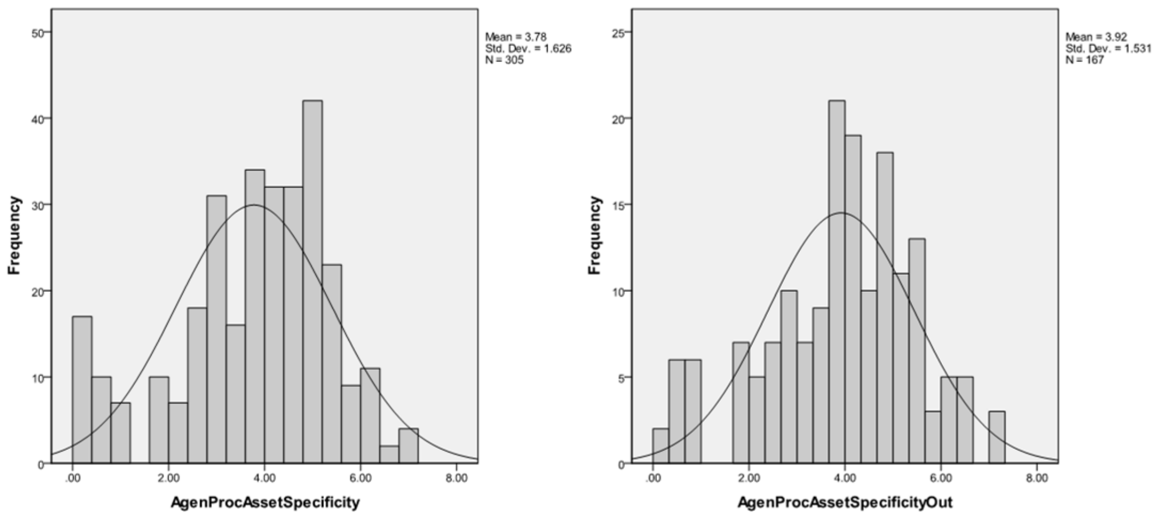


Figure B-22. Agents' procedural asset specificity variable histograms after outlier removal (left: 360 case dataset; right: 195 case dataset)

Table B-11. Statistical assessment of normality - Agents' procedural asset specificity

	Original distributions		Pruned distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.000	.000	.000
Shapiro Wilk statistic (sig.)	.000	.000	.000	.001

A reiterative visual inspection of the newly formed histograms argues for acceptable levels of normality in both datasets; a proposition supported only by a marginal improvement in the Shapiro-Wilk test for the 195 case dataset.

With regard to the agents' temporal asset specificity variable, the associated original histograms (Figure B-23) do not reveal the presence of particular skewness with only some kurtotic tendencies present. Visual inspections do not detect significant deviations from normality in the 195 case dataset while some abnormality is observed in the 360 case dataset. The assessment is only partially supported by the K-S statistic (found significant at the .01 level in the 195 case dataset) (Table B-12). The initial assessment detected 5 low outliers in both datasets. Given the absence of a particular type of skewness, no transformations are applied to the variables. Figure B-24 presents the variables' distributions after the removal of outliers.

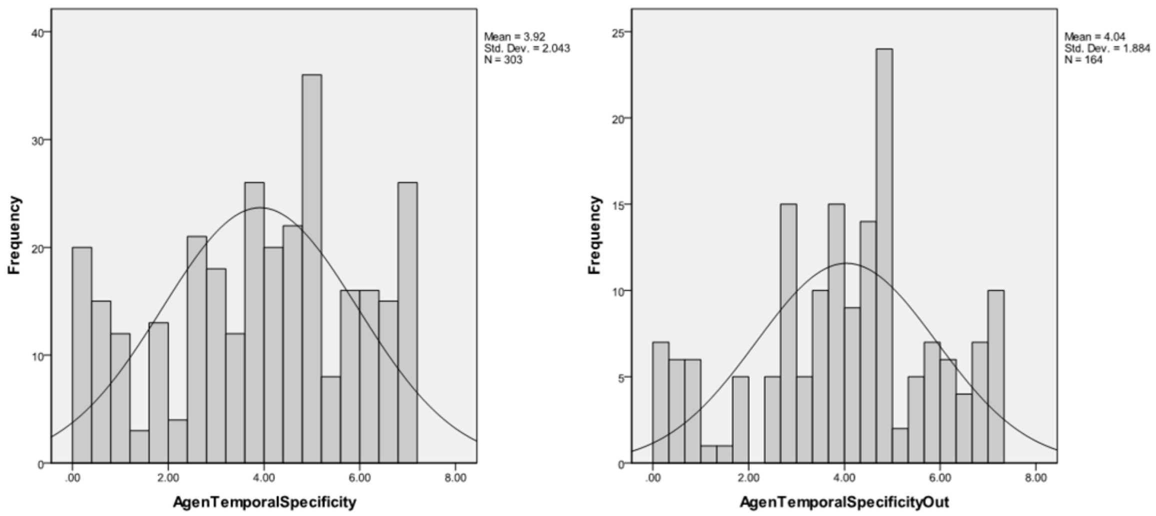


Figure B-23. Agents' temporal asset specificity variable original histograms (left: 360 case dataset; right: 195 case dataset)

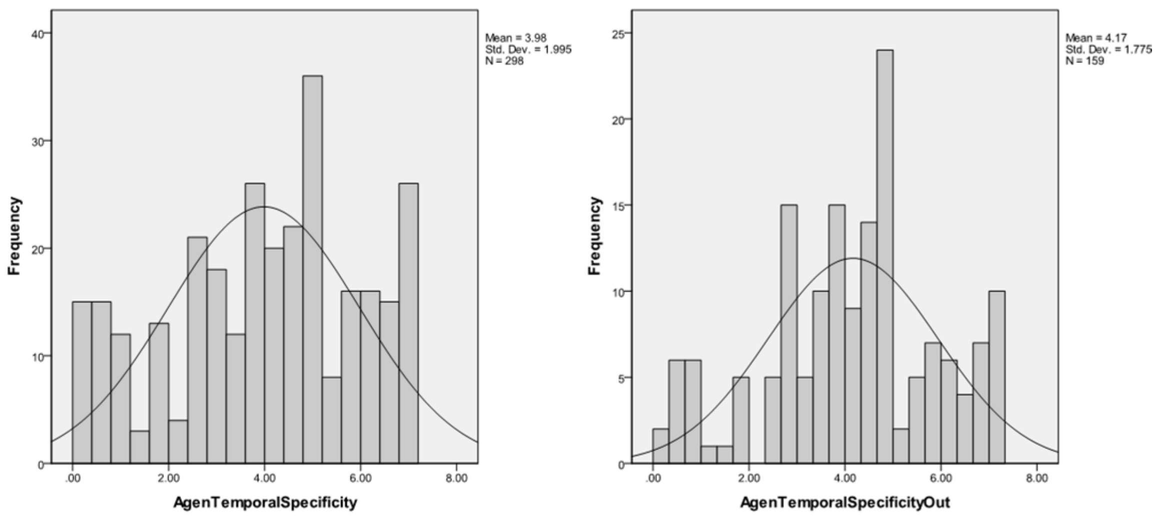


Figure B-24. Agents' temporal asset specificity variable histograms after outlier removal (left: 360 case dataset; right: 195 case dataset)

Table B-12. Statistical assessment of normality - Agents' temporal asset specificity

	Original distributions		Pruned distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.005	.000	.027
Shapiro Wilk statistic (sig.)	.000	.000	.000	.000

A reiterative visual inspection of the newly formed histograms argues for acceptable levels of normality in both datasets; a proposition supported only by a significant improvement of the Kolmogorov-Smirnov test in the 195 case dataset (found to be significant at the .05 level).

Agent's Proprietary Asset Exposure

With regard to the agents' brand name capital exposure variables, the associated original histograms (Figure B-25) reveal only minor elements of negative skewness in both datasets. Initial visual inspections detect minor deviations from normality in both datasets; an assessment not further supported by the K-S and S-W test statistics (found to be significant at the .001 level) (Table B-13). The initial assessment detected the presence of five low outliers in both datasets. Given the observance of only little skewness, no transformations are applied to the variables. Figure B-26 presents the variables' distributions after the removal of outliers.

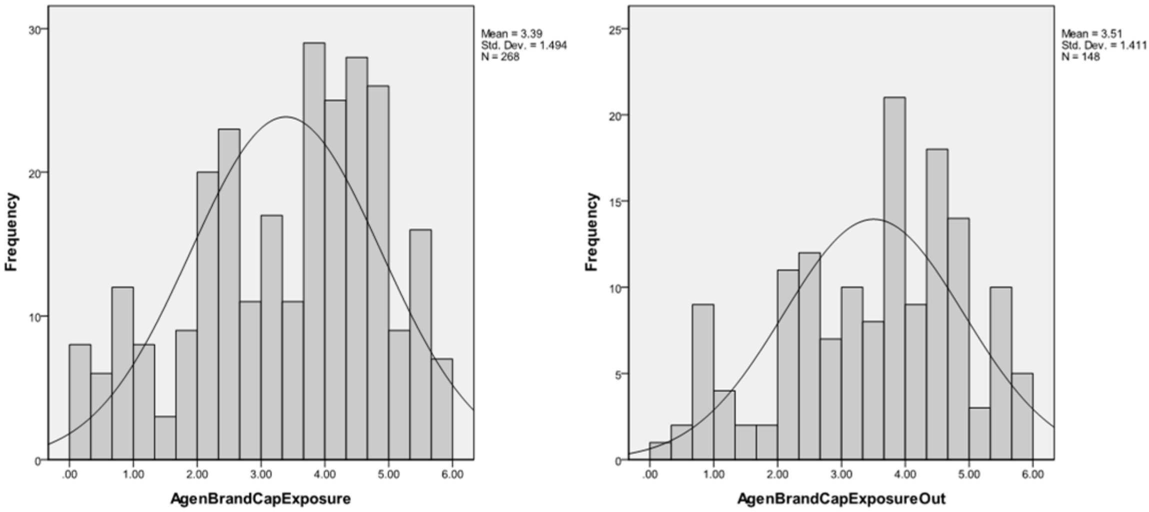


Figure B-25. Agents' brand name capital exposure variable original histograms (left: 360 case dataset; right: 195 case dataset)

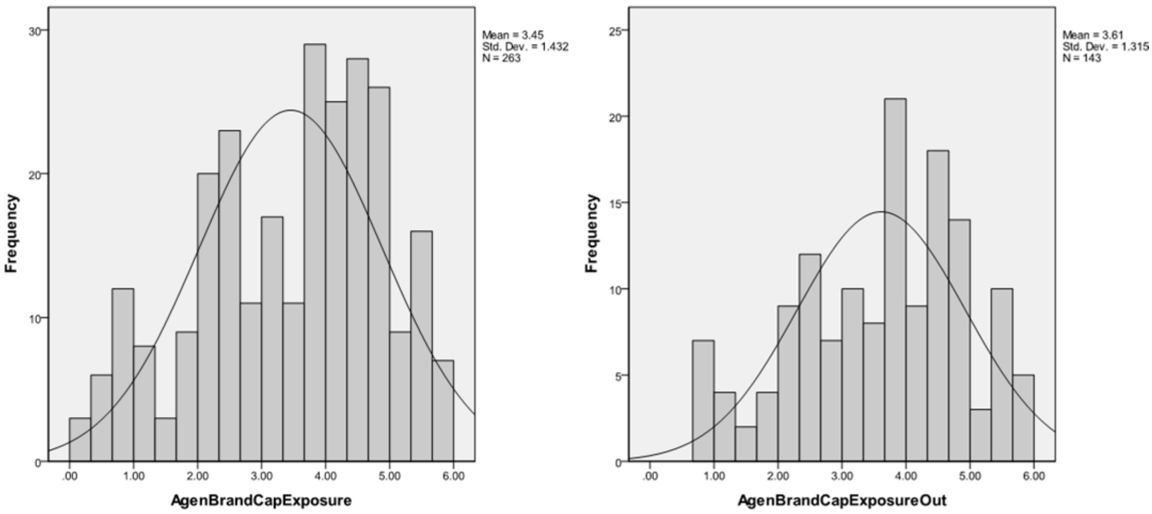


Figure B-26. Agents' brand name capital exposure variable histograms after outlier removal (left: 360 case dataset; right: 195 case dataset)

Table B-13. Statistical assessment of normality - Agents' brand name capital exposure

	Original distributions		Pruned distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.001	.000	.002
Shapiro Wilk statistic (sig.)	.000	.000	.000	.001

A reiterative visual inspection recognizes a marginal improvement in the variables' deviation from normality; a proposition partially supported by a marginal improvement in both the K-S and S-W tests in the 195 case dataset (both found significant at the .01 level).

With regard to the agents' proprietary information exposure variables, the associated original histograms (Figure B-27) reveal the presence of some positive skewness in both datasets. Initial visual inspections detect deviations from normality in both datasets; an assessment supported by both the K-S and S-W test statistics (found to be significant at the .001 level) (Table B-14). The initial assessment detected four low outliers in the 360 case dataset and one high and three low outliers in the 195 case dataset. Given the presence of positive skewness, square root transformations are applied to the variables. Figure B-28 presents the variables' distributions after the removal of outliers and the application of transformations.

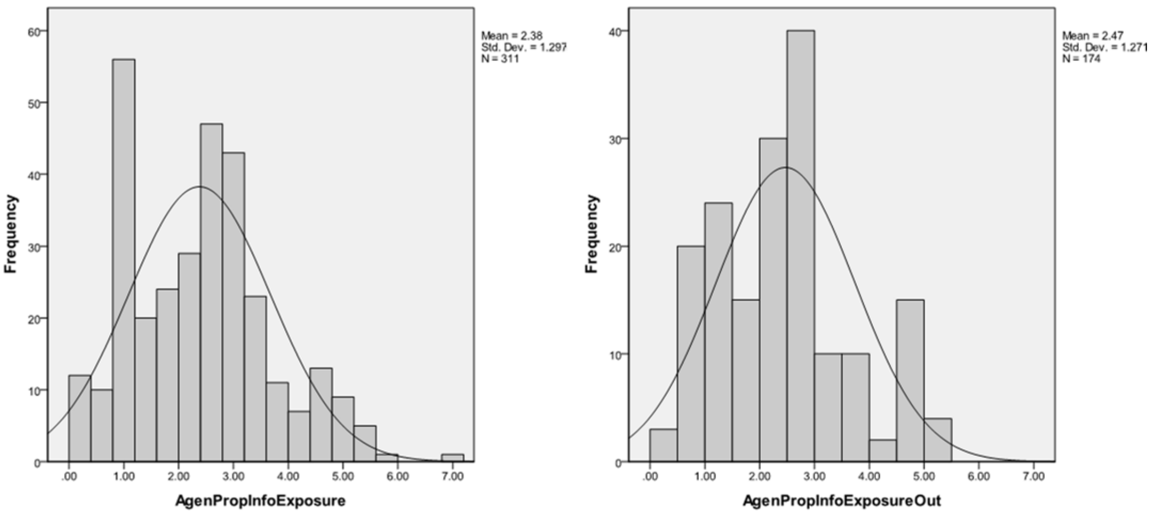


Figure B-27. Agents' proprietary information exposure variable original histograms (left: 360 case dataset; right: 195 case dataset)

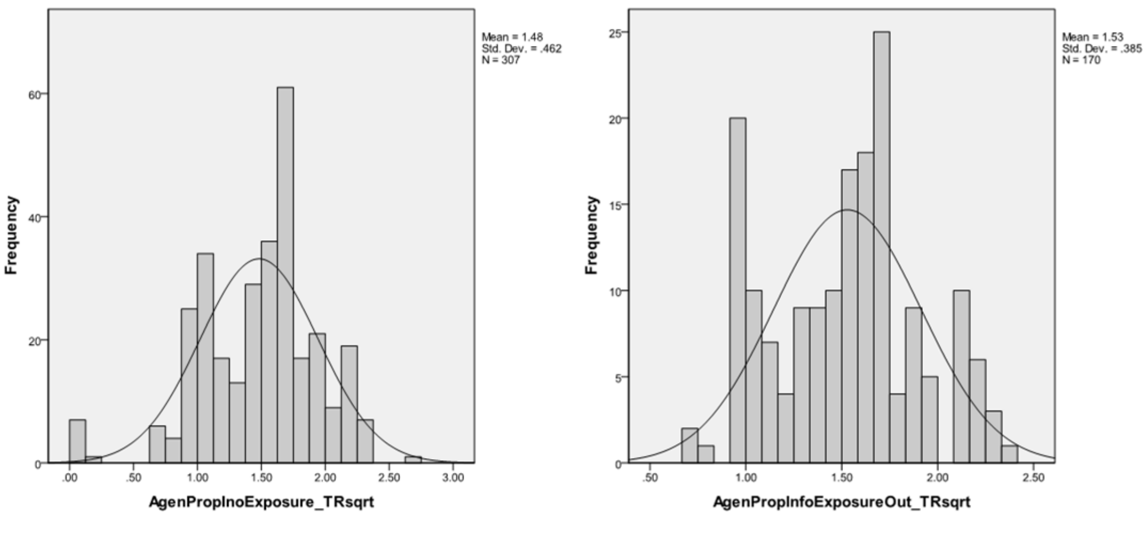


Figure B-28. Agents' proprietary information exposure variable histograms after outlier removal and transformations (left: 360 case dataset; right: 195 case dataset)

Table B-14. Statistical assessment of normality - Agents' proprietary information exposure

	Original distributions		Pruned & transf. distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.000	.000	.007
Shapiro Wilk statistic (sig.)	.000	.000	.000	.001

A reiterative visual inspection of the new histograms recognizes improvements in the variables' deviation from normality; a proposition supported by a noticeable improvement in both the K-S and S-W tests in the 195 case dataset were both are now significant only at the .01 level.

Behavioural Uncertainty

With regard to the variable of behavioural uncertainty, the associated original histograms (Figure B-29) reveal the presence of negligible skewness and a measure of kurtosis in both datasets. Initial visual inspections detect minor deviations from normality in both datasets; an assessment not further supported by the K-S and S-W test statistics (found to be significant at the .001 level) (Table B-15). The initial assessment detected the presence of five high outliers in both datasets. Given the observance of only limited skewness, no transformations are applied to the variables. Figure B-30 presents the variables' distributions after the removal of outliers.

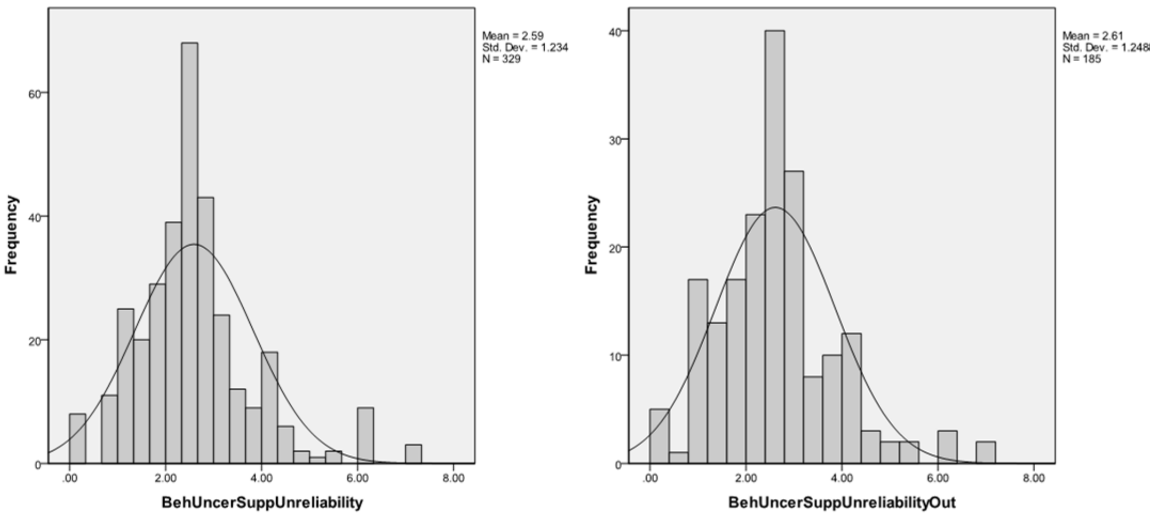


Figure B-29. Behavioural uncertainty variable original histograms
(left: 360 case dataset; right: 195 case dataset)

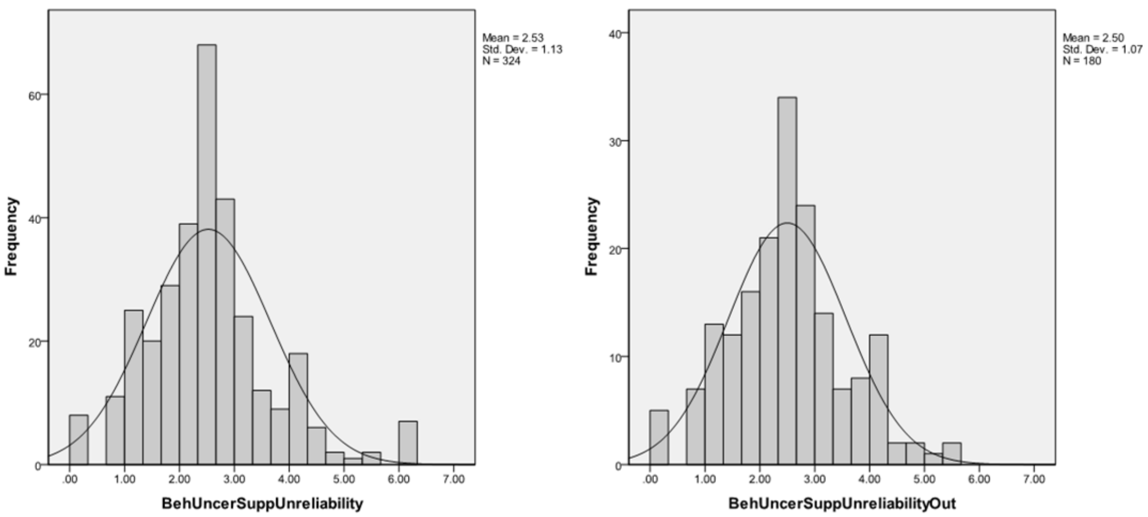


Figure B-30. Behavioural uncertainty variable histograms after outlier removal
(left: 360 case dataset; right: 195 case dataset)

Table B-15. Statistical assessment of normality - Behavioural uncertainty (unreliability of suppliers)

	Original distributions		Pruned distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.000	.000	.005
Shapiro Wilk statistic (sig.)	.000	.000	.000	.038

A reiterative visual inspection verifies the initial findings of only minor deviations from normality. Interestingly, a significant improvement is observed in the 195 case dataset tests where the K-S statistic is now significant at the .01 level while the S-W statistic is significant only at the .05 level.

Volume Uncertainty

With regard to the variable of volume uncertainty, the associated original histograms (Figure B-31) reveal the presence of some skewness in the 360 case dataset with negligible kurtotic tendencies in the 195 case dataset. Initial visual inspections detect minor deviations from normality; an assessment supported by both statistics as the K-S statistic is significant at the .01 level in the 360 case dataset and the S-W only at the .05 level in the 195 case dataset (Table B-16). The initial assessment detected the presence of two high outliers in both datasets. Given the presence of limited skewness, no transformations are applied. Figure B-32 presents the variables' distributions after the removal of outliers.

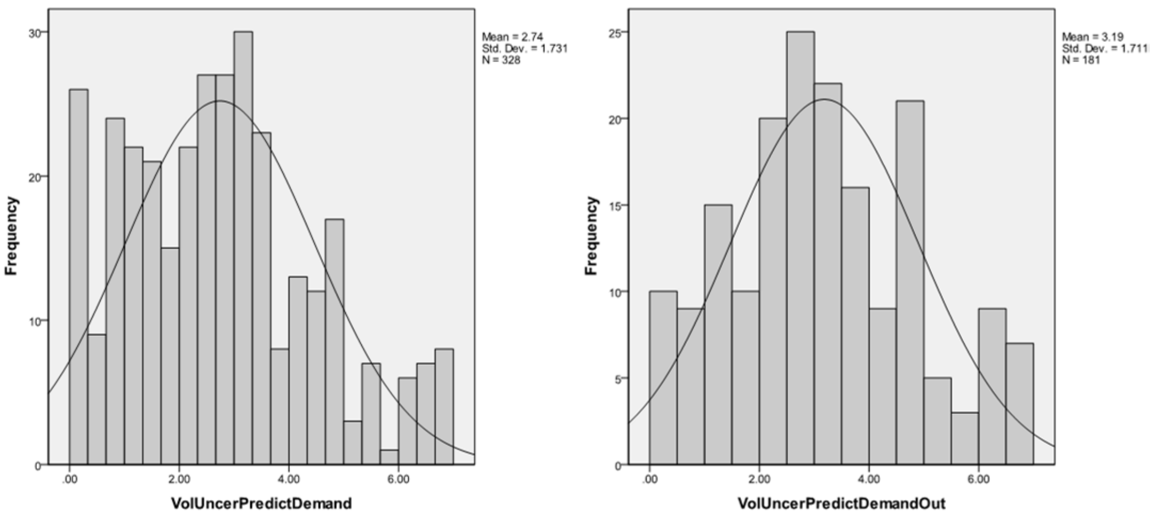


Figure B-31. Volume uncertainty variable original histograms
(left: 360 case dataset; right: 195 case dataset)

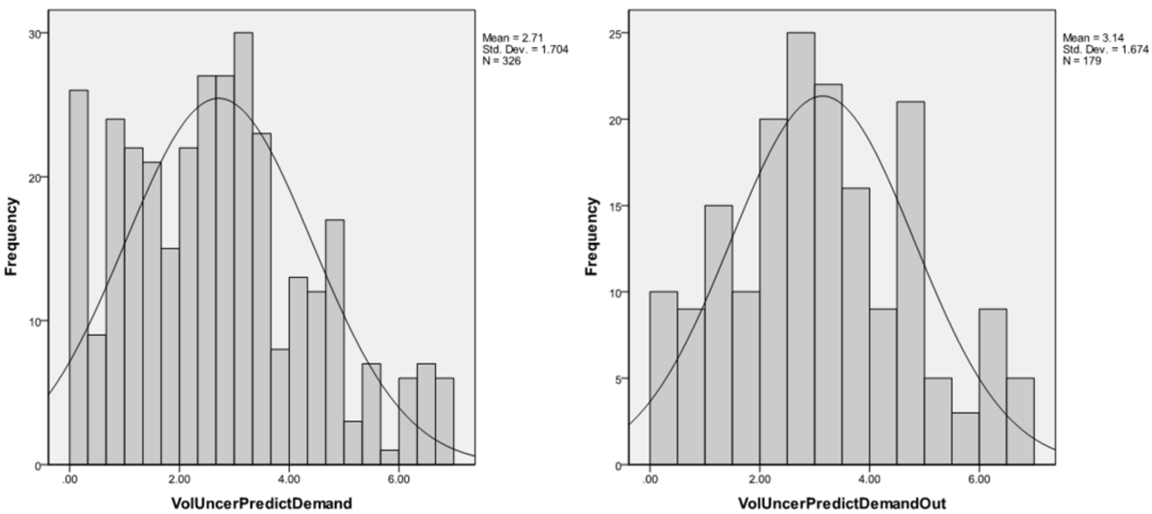


Figure B-32. Volume uncertainty variable histograms after outlier removal
(left: 360 case dataset; right: 195 case dataset)

Table B-16. Statistical assessment of normality - Volume uncertainty (unpredictability of demand)

	Original distributions		Pruned distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.003	.028	.002	.047
Shapiro Wilk statistic (sig.)	.000	.007	.000	.013

A reiterative visual inspection of the newly formed histograms verifies the initial findings of only minor deviations from normality in both datasets. Significant improvements are further observed in the 195 case dataset's tests where the K-S statistic is now marginally significant at the .05 level.

Technological Uncertainty

In examining technological uncertainty's components, the variables of speed and unpredictability of technological developments are assessed. With regard to the variable of technological development speed, the associated original histograms (Figure B-33) reveal the presence of only limited positive kurtosis in both datasets. Initial visual inspections detect minor deviations from normality in both datasets; an assessment supported mainly by the Shapiro-Wilk test statistics where they are found to be significant at the .01 level in the 360 case dataset and at the .05 level in the 195 case dataset (Table B-17). Given that the variable is not meant for direct input in either multiple linear regression or logistic regression analysis, the application of any transformations or outlier removals is not considered. Rather, such actions are taken into consideration at the level of the composite technological uncertainty variable that reflects the overarching construct of interest.

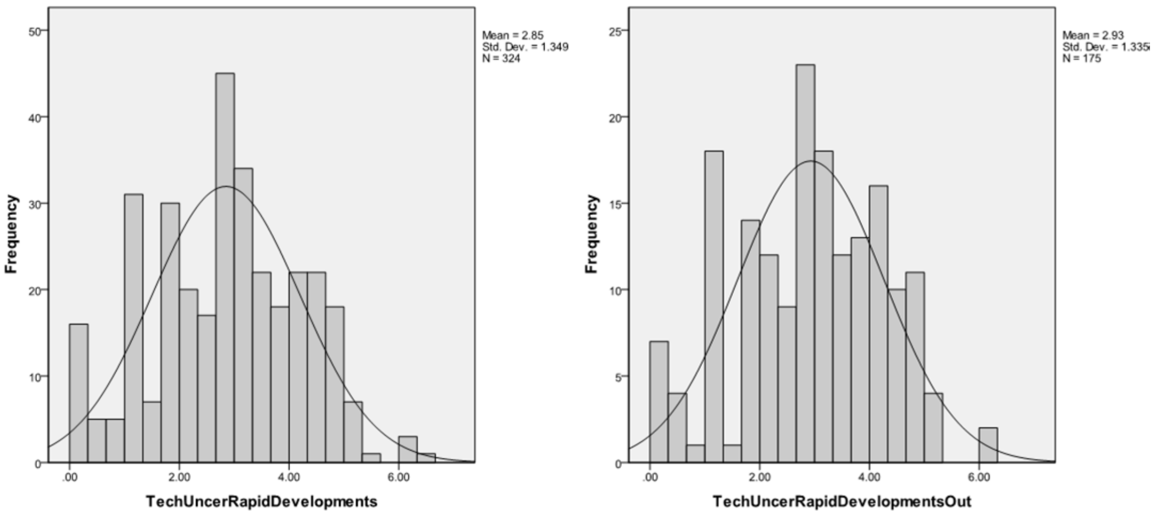


Figure B-33. Technological development speed variable original histograms (left: 360 case dataset; right: 195 case dataset)

Table B-17. Statistical assessment of normality - Speed of technological developments

	Original distributions		Pruned distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.009	no transformations or outlier removals applied	
Shapiro Wilk statistic (sig.)	.001	.015		

With regard to the variable of technological development unpredictability, the associated original histograms (Figure B-34) again reveal the presence of only limited positive kurtosis in both datasets. Initial visual inspections detect minor deviations from normality in both datasets; an assessment supported by the K-S statistic in the 360 case dataset and by both K-S and S-W tests in the 195 case dataset (Table B-18). Again, given that the variable is not meant for direct input in any regression analysis, the application of any transformations or outlier removals is not considered. The aforementioned treatments are once more reserved for the overarching composite variable of technological uncertainty.

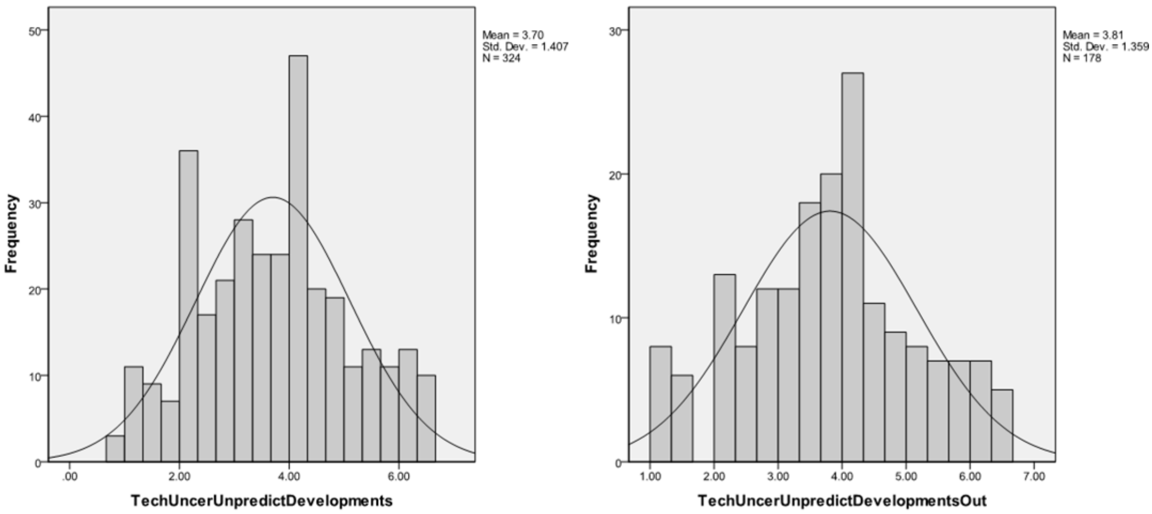


Figure B-34. Technological development unpredictability variable original histograms (left: 360 case dataset; right: 195 case dataset)

Table B-18. Statistical assessment of normality - Unpredictability of technological developments

	Original distributions		Pruned distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.004	.015	no transformations or outlier removals applied	
Shapiro Wilk statistic (sig.)	.000	.019		

With regard to the composite variable of technological uncertainty (operationalized as the product of technological development speed and unpredictability), the associated original histograms (Figure B-35) reveal the presence of some positive skewness along with elements of positive kurtosis. Initial visual inspections detect a significant deviation from normality; an assessment concurred by both the K-S and S-W test statistics (found to be significant at the .001 level) (Table B-19). The initial assessment did not detect the presence of any outliers or extreme values. Given the presence of negative skewness, square root transformations were applied. Figure B-36 presents the variables' distributions after the relevant transformations.

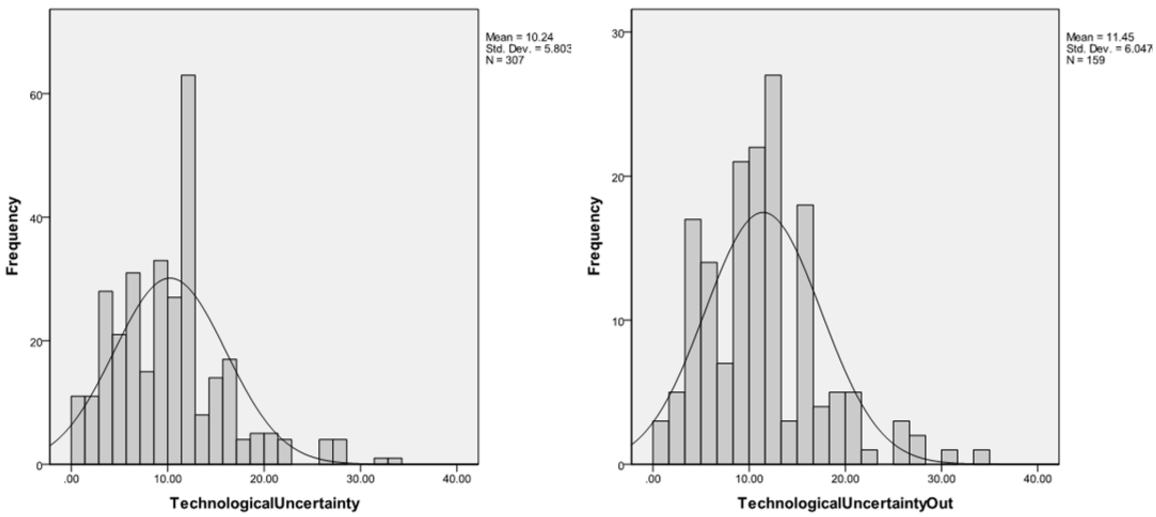


Figure B-35. Technological uncertainty variable original histograms (left: 360 case dataset; right: 195 case dataset)

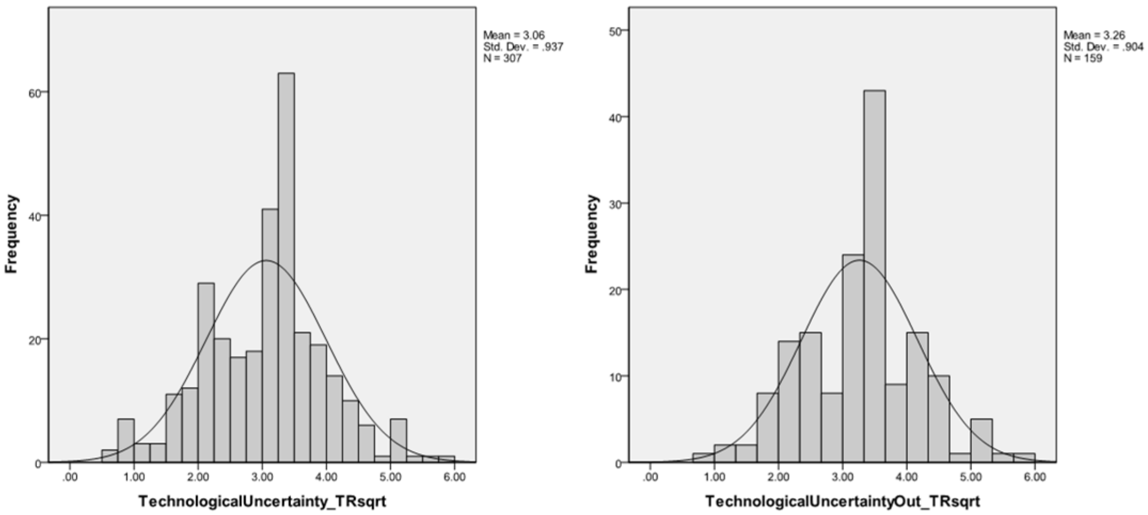


Figure B-36. Technological uncertainty variable histograms after transformations (left: 360 case dataset; right: 195 case dataset)

Table B-19. Statistical assessment of normality - Technological uncertainty (speed x unpredictability)

	Original distributions		Pruned distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.000	.000	.007
Shapiro Wilk statistic (sig.)	.000	.000	.001	.074

A reiterative visual inspection recognizes improvements in the variables' deviation from normality; an assessment largely supported by the K-S statistic in the 195 case dataset that is found not to be significant at the .05 level. In the 360 case dataset, improvement is indicated by a marginal improvement of the S-W statistic that is now significant at the 0.01 level.

Value Assessment Ability

With regard to the variable of value assessment ability, the associated original histograms (Figure B-37) are found to exhibit good conformity with normality assumptions in both datasets. The assessment is principally supported by the Kolmogorov-Smirnov test as its statistics are found to be significant only at the .05 level in both datasets (Table B-20).

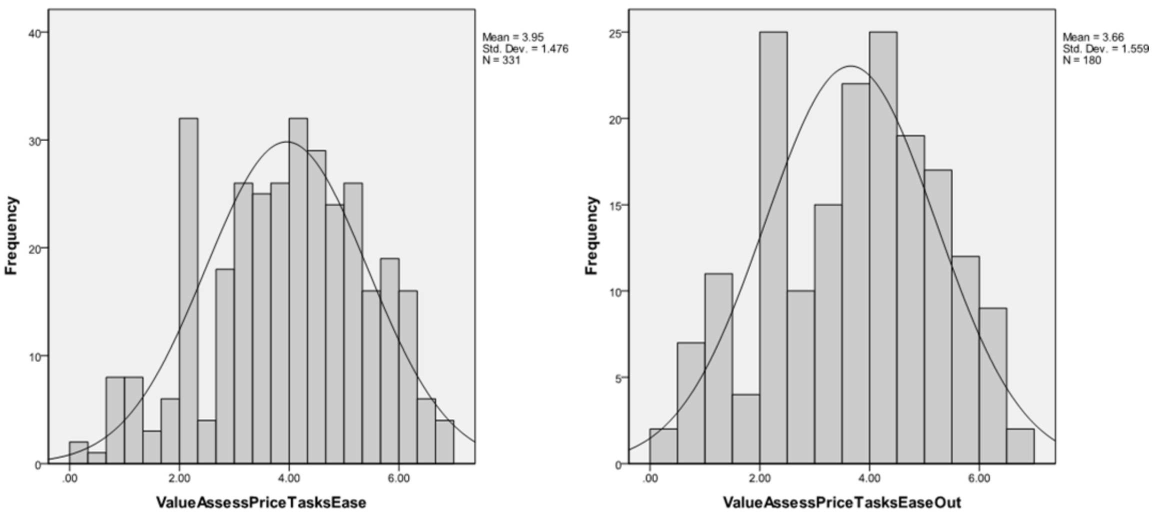


Figure B-37. Value assessment ability variable original histograms (left: 360 case dataset; right: 195 case dataset)

Table B-20. Statistical assessment of normality - Value assessment ability (task pricing ease)

	Original distributions		Pruned distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.040	.018	no transformations or outlier removals applied	
Shapiro Wilk statistic (sig.)	.000	.006		

The initial assessment did not detect the presence any outliers or extreme values, while the absence of skewness does not warrant the application of any transformations. As such, the variable remains in the analysis as is.

Contribution Assessment Ability

With regard to the variable of contribution assessment ability (operationalized through the ease of evaluating suppliers in a maintenance activity), the associated original histograms (Figure B-38) are found to exhibit reasonable conformity with normality assumptions in both datasets. The assessment is generally not supported by the statistics tests, since only the S-W statistic is marginally found to be not significant at the .001 level (Table B-21). The initial assessment did not detect the presence of any outliers or extreme values, while the absence of skewness does not warrant the application of any transformations. As such, the variable remains in the analysis as is.

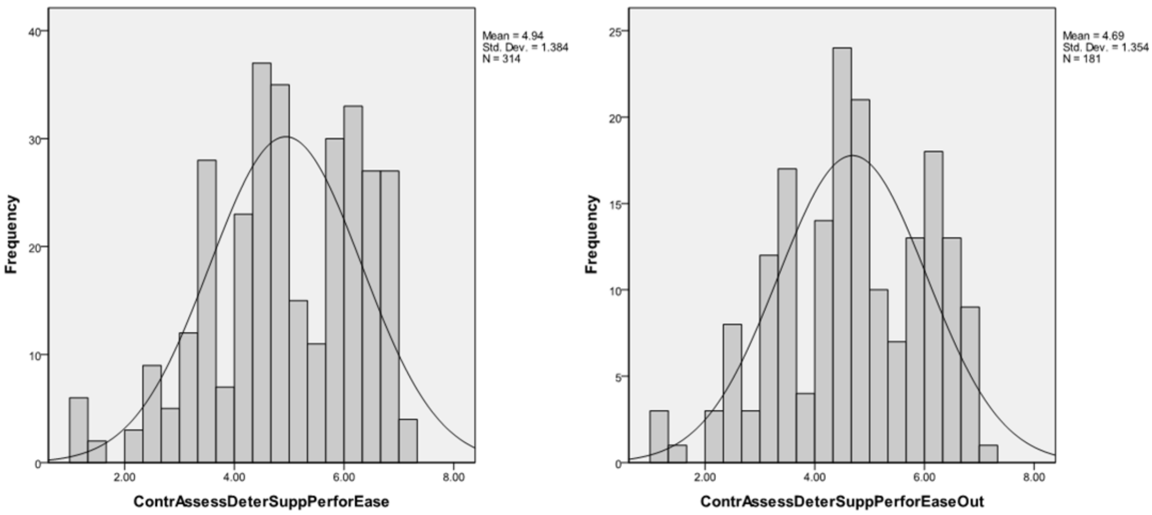


Figure B-38. Contribution assessment ability variable original histograms (left: 360 case dataset; right: 195 case dataset)

Table B-21. Statistical assessment of normality - Contribution assessment ability (supplier evaluation ease)

	Original distributions		Pruned distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.000	no transformations or outlier removals applied	
Shapiro Wilk statistic (sig.)	.000	.001		

Transaction Frequency

Concluding, finally, the examination of efficiency-based variables, emphasis is put on transaction frequency. The variables original histograms (Figure B-39) are found to exhibit reasonable conformity with normality assumptions in both datasets (with the 360 case dataset being the more precarious assertion). The assessment is generously supported by the K-S statistic for the 195 case dataset (found not to be significant at all) and only marginally supported by the same statistic in the 360 case dataset (found to be significant at the .01 level) (Table B-22). The initial assessment did not detect the presence of any outliers, while the absence of skewness does not warrant the application of any transformations. As such, the variable remains in the analysis as is.

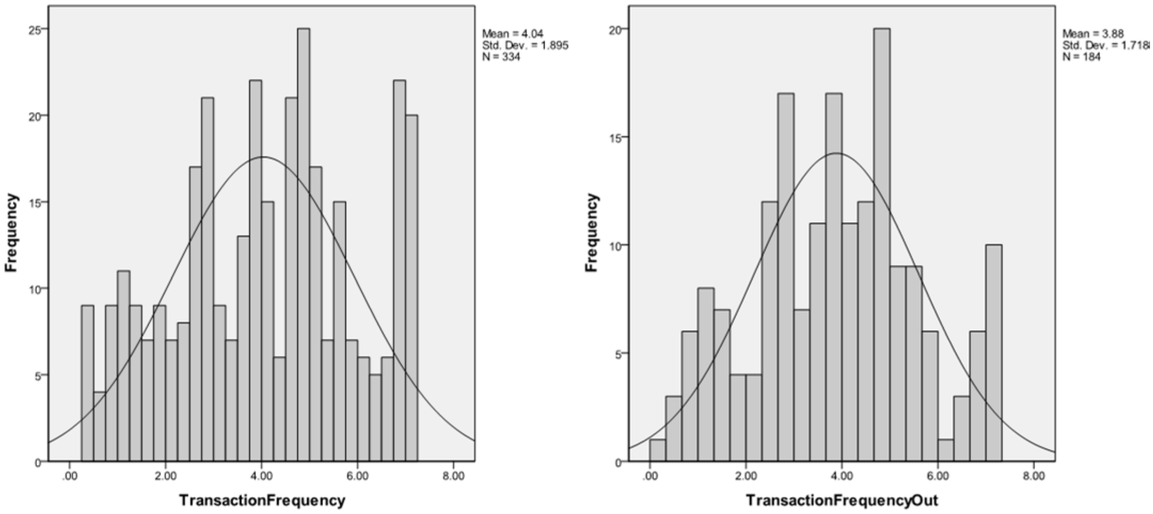


Figure B-39. Transaction frequency variable original histograms (left: 360 case dataset; right: 195 case dataset)

Table B-22. Statistical assessment of normality - Transaction frequency

	Original distributions		Transformed distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.004	.200	no transformations or outlier removals applied	
Shapiro Wilk statistic (sig.)	.000	.002		

B.2.2 Dependency-based variable data screening

Having concluded the screening process for the efficiency-based variables, focus is now put on the variables associated with dependency considerations. Primarily, the components of the power imbalance variable are considered (i.e. principals' dependence and agents' dependence).

Power imbalance

With regard to the principals' resource criticality variable, the associated original histograms (Figure B-40) reveal the presence of severe negative skewness along with elements of positive kurtosis. Initial visual inspections detect a significant deviation from normality; an assessment concurred by both the K-S and S-W test statistics (found to be significant at the .001 level) (Table B-23).

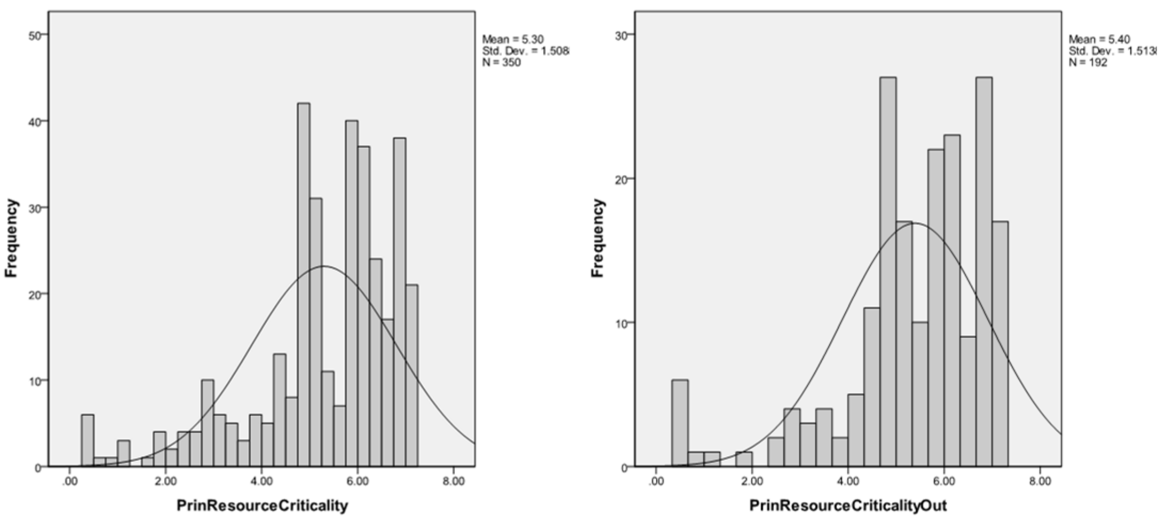


Figure B-40. Principals' resource criticality variable original histograms (left: 360 case dataset; right: 195 case dataset)

Table B-23. Statistical assessment of normality - Principals' resource criticality

	Original distributions		Transformed distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.000	no transformations or outlier removals applied	
Shapiro Wilk statistic (sig.)	.000	.000		

Given that the variable is not meant for direct input in either multiple linear regression or logistic regression analysis, the application of any transformations or outlier removals is not considered. Rather, such actions are taken into consideration at the level of the composite principals' dependence on agents variable that is one of the variables directly forming the power imbalance overarching construct.

As such, focus is then put on the other forming variable of the principals' dependence, which is the principals' potential for oligopolistic suppliers (operationalized as one over the number of the principals' available supply sources). The variable's associated original histograms (Figure B-41) reveal the presence of severe positive skewness along with elements of positive kurtosis. Initial visual inspections detect a significant deviation from normality; an assessment concurred by both the K-S and S-W test statistics (found to be significant at the .001 level) (Table B-24).

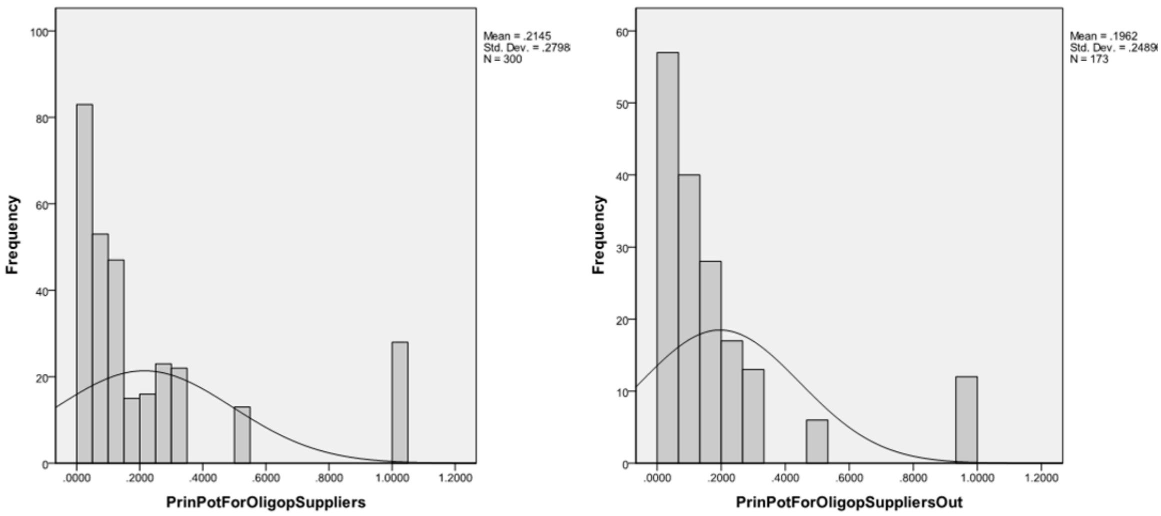


Figure B-41. Principals' potential for oligopolistic suppliers variable original histograms (left: 360 case dataset; right: 195 case dataset)

Table B-24. Statistical assessment of normality - Principals' potential for oligopolistic suppliers

	Original distributions		Transformed distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.000	no transformations or outlier removals applied	
Shapiro Wilk statistic (sig.)	.000	.000		

Once more, given that the variable is not meant for direct input in either multiple linear regression or logistic regression analysis, exactly like in the case of the principals' resource criticality variable, the application of any transformations or outlier removals is not considered. Consequently, focus is put on the principals' dependence on agents variable.

With regard to the principals' dependence variable (operationalized as the product of the principals' resource criticality and potential for oligopolistic suppliers), the associated original histograms (Figure B-42) reveal the presence of extreme positive skewness along with severe positive kurtosis. Initial visual inspections detect a significant deviation from normality; an assessment concurred by both the K-S and S-W test statistics (found to be significant at the .001 level) (Table B-25). Given the presence of extreme skewness and kurtosis the variable is transformed through a logarithmic function with a base of 10. Figure B-43 presents the variables' distributions after the relevant transformations.

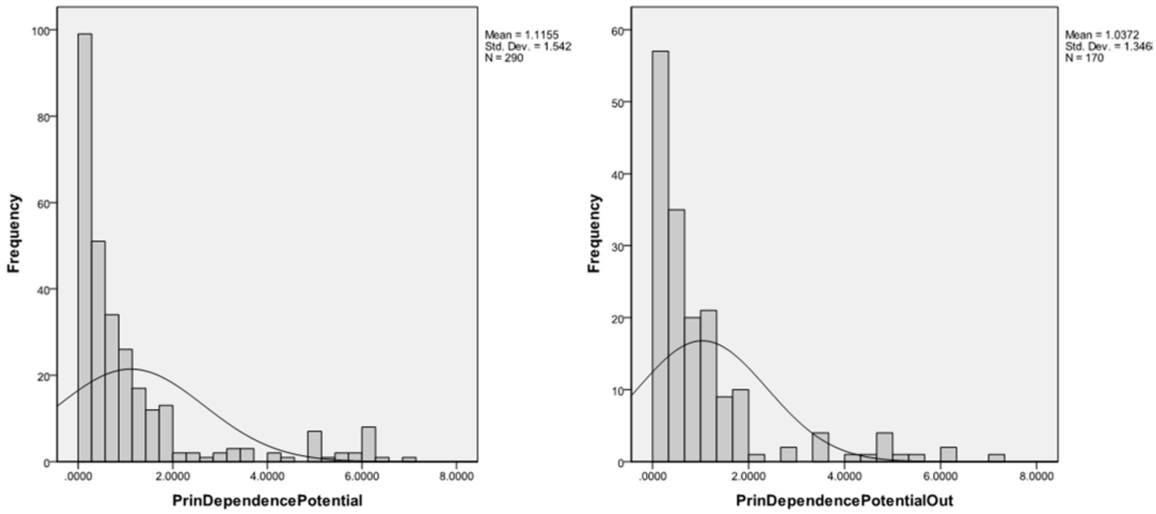


Figure B-42. Principals' dependence on agents variable original histograms (left: 360 case dataset; right: 195 case dataset)

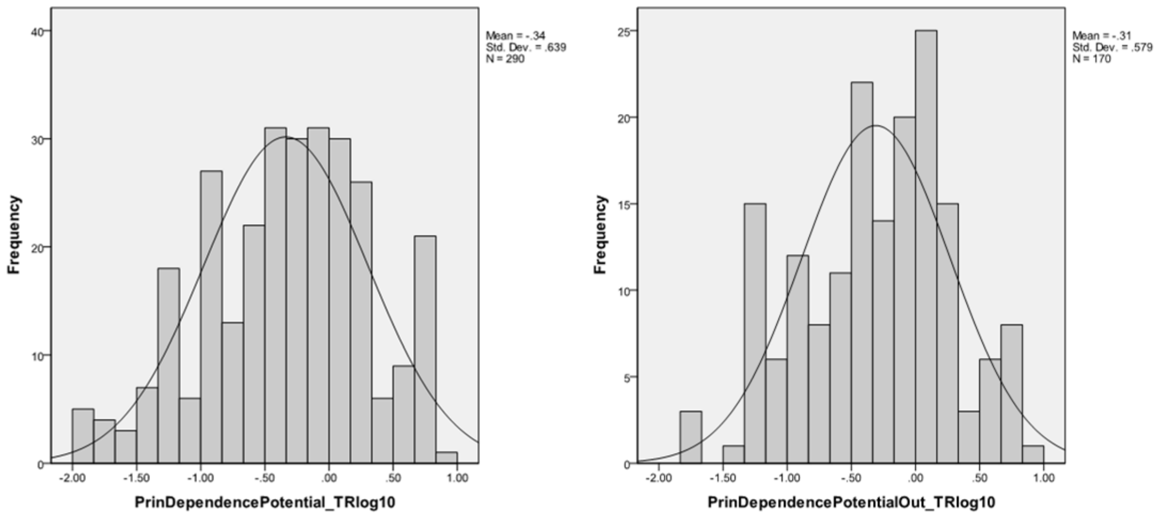


Figure B-43. Principals' dependence on agents variable histograms after transformations (left: 360 case dataset; right: 195 case dataset)

Table B-25. Statistical assessment of normality - Principals' dependence on agents (criticality x pot. for olig.)

	Original distributions		Transformed distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.000	.022	.024
Shapiro Wilk statistic (sig.)	.000	.000	.001	.011

A reiterative visual inspection of the newly formed histograms recognizes significant improvements in the variables' deviation from normality. The assertion is further concurred principally through the Kolmogorov-Smirnov test which is found to be significant only at the .05 level in both datasets. Improvements are also registered in the S-W test, but to a lesser degree.

Moving then to the agents' dependence forming variables, the agents' resource criticality variable is examined. The associated original histograms (Figure B-44) reveal the presence of only minor kurtotic properties. Initial visual inspections do not detect significant deviations from normality; an assessment concurred by both the K-S and S-W tests in the 195 case dataset with the K-S statistic found not to be significant at the .05 level and the S-W statistic found significant at the .05 level (Table B-26). Similarly to the process followed for the forming components of the principals' dependence construct no transformations or outlier removals are considered as the focal variable is not meant for direct input in either multiple linear regression or logistic regression analysis.

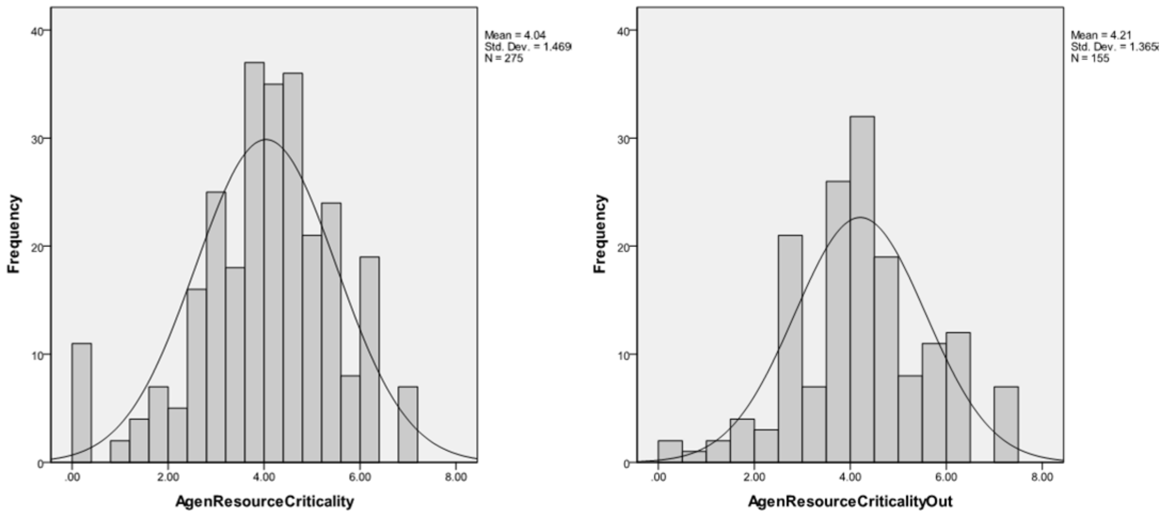


Figure B-44. Agents' resource criticality variable original histograms (left: 360 case dataset; right: 195 case dataset)

Table B-26. Statistical assessment of normality - Agents' resource criticality

	Original distributions		Transformed distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.099	no transformations or outlier removals applied	
Shapiro Wilk statistic (sig.)	.000	.020		

With regard to the agents' potential for oligopsonistic clients variable (operationalized as one over the number of the agents' alternative supply outputs), the associated original histograms (Figure B-45) reveal the presence of extreme positive skewness along with severe kurtotic tendencies. Initial visual inspections detect a significant deviation from normality; an assessment concurred by both the K-S and S-W test statistics (found to be significant at the .001 level) (Table B-27).

Once again, since the variable is not meant for direct input in either multiple linear regression or logistic regression analysis, exactly like in the case of the agents' resource criticality variable, the application of any transformations or outlier removals is not considered. Consequently, focus is put on the agents' dependence on principals variable.

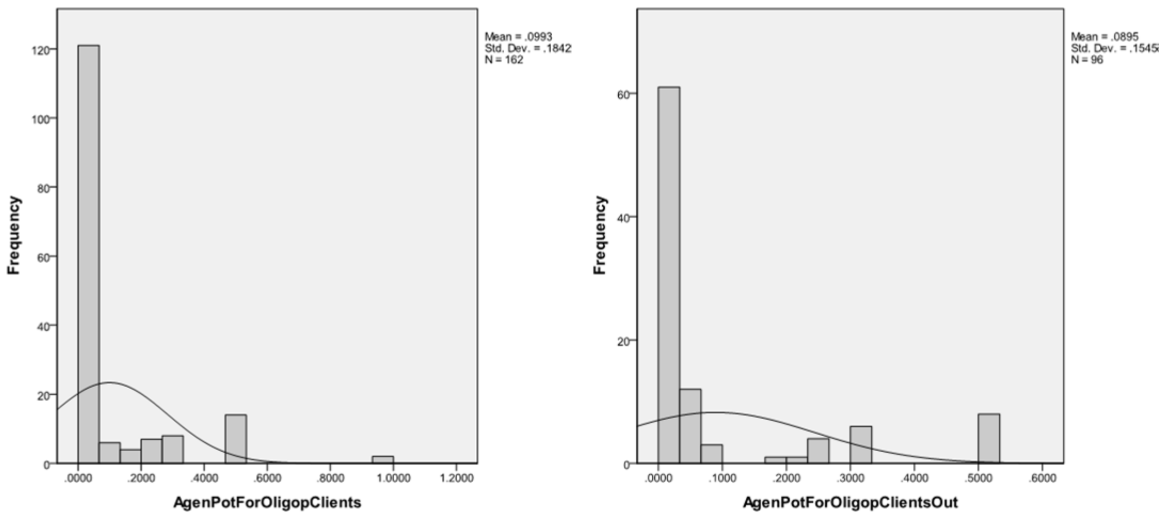


Figure B-45. Agents' resource criticality variable original histograms (left: 360 case dataset; right: 195 case dataset)

Table B-27. Statistical assessment of normality - Agents' potential for oligopsonistic clients

	Original distributions		Transformed distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.000	no transformations or outlier removals applied	
Shapiro Wilk statistic (sig.)	.000	.000		

With regard to the agents' dependence variable (operationalized as the product of the agents' resource criticality and potential for oligopsonistic clients), the associated original histograms (Figure B-46) reveal the presence of extreme positive skewness along with severe positive kurtosis. Initial visual inspections detect a significant deviation from normality; an assessment concurred by both the K-S and S-W test statistics (found to be significant at the .001 level) (Table B-28). Given the presence of extreme skewness and kurtosis the variable is transformed through a logarithmic function with a base of 10. Figure B-47 presents the variables' distributions after the relevant transformations.

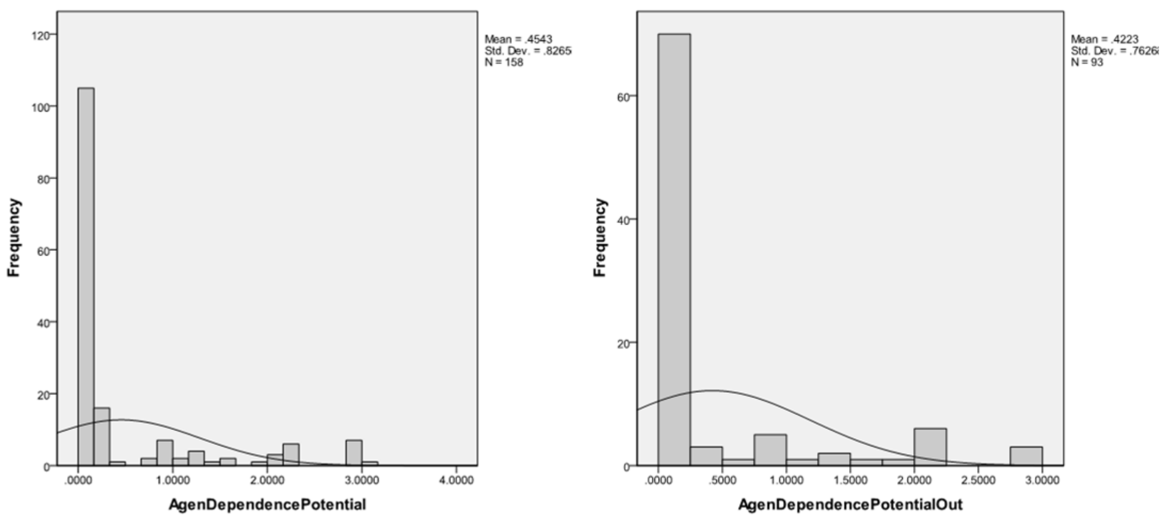
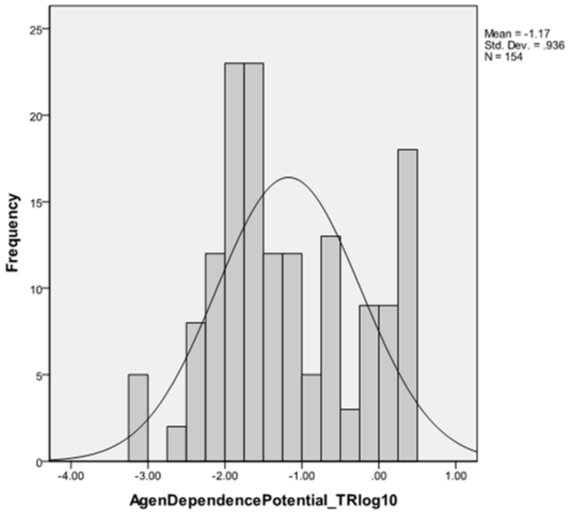


Figure B-46. Agents' dependence on principals variable original histograms (left: 360 case dataset; right: 195 case dataset)



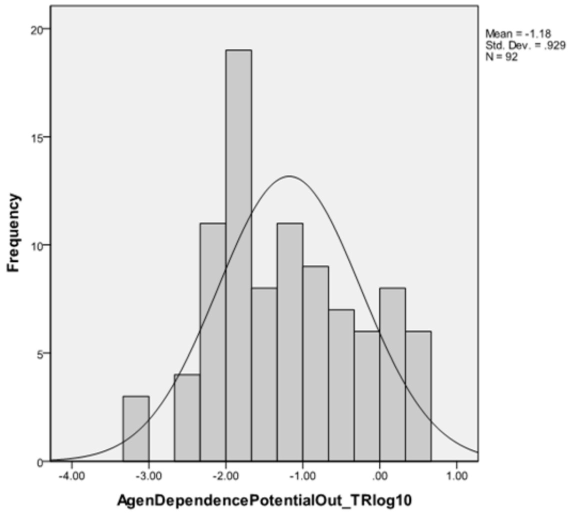


Figure B-47. Agents' dependence on principals variable histograms after transformations (left: 360 case dataset; right: 195 case dataset)

Table B-28. Statistical assessment of normality - Agents' dependence on principals (criticality x pot. for olig.)

	Original distributions		Transformed distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.000	.000	.013
Shapiro Wilk statistic (sig.)	.000	.000	.000	.005

A reiterative visual inspection of the newly formed histograms recognizes significant improvements in the variables' deviation from normality. The assertion is supported by both the K-S and S-W test in the 195 case dataset where the first is now significant at the .05 level while the second at the .01 level. No statistical test improvements are registered for the 360 case dataset.

Unfortunately, given the increased percentage of missing values present in the agent's dependence variable (registered at over 57% in the 360 case dataset and nearly 53% in the 195 case dataset) further analysis of the power imbalance composite variable is forfeited. The issue is reiteratively addressed in the missing values section of chapter 9. At this point, it is simply stated that the input of the particular composite variable in multiple linear or logistic regression with more than half of the cases missing is considered ill-advised. As such, focus is put on the rest of the dependency-based variables.

Resource Internalization Potential

With regard to the resource internalization potential variable (operationalized as the difficulty of internalizing a resource), the associated original histograms (Figure B-48) reveal the presence of positive skewness. Initial visual inspections detect a deviation from normality; an assessment concurred by both the K-S and S-W test statistics (found to be significant at the .001 level) (Table B-29). Given the presence of positive skewness, square root transformations are applied to the variables. Figure B-49 presents the variables' distributions after the relevant transformations.

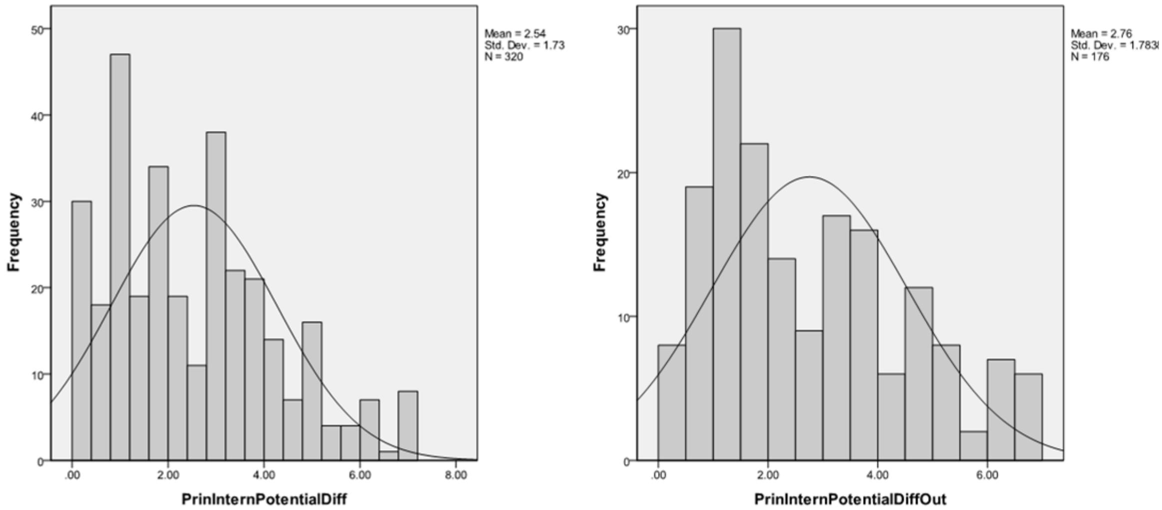


Figure B-48. Resource internalization potential (difficulty) variable original histograms (left: 360 case dataset; right: 195 case dataset)

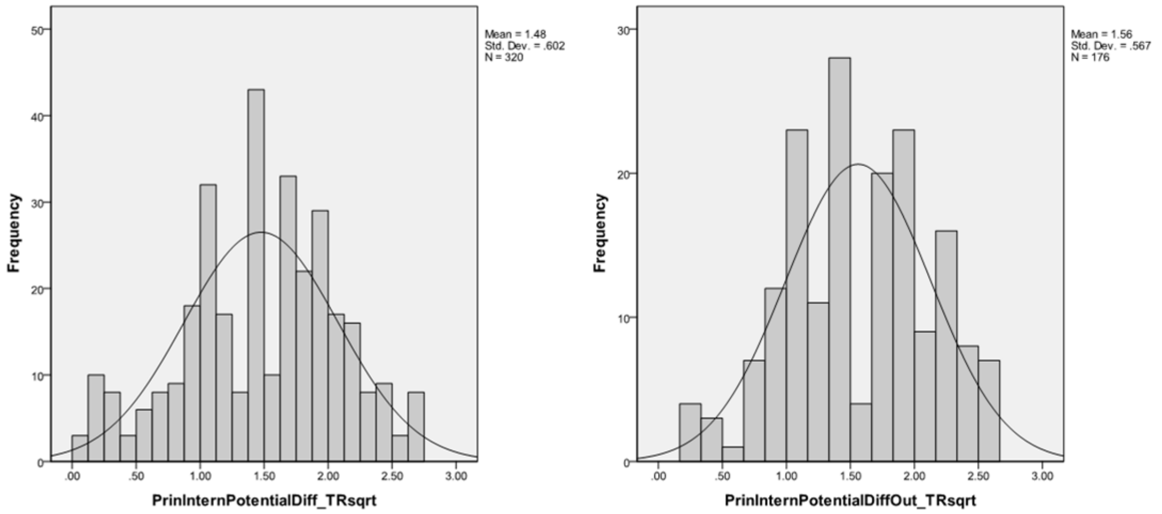


Figure B-49. Resource internalization potential (difficulty) variable histograms after transformations
(left: 360 case dataset; right: 195 case dataset)

Table B-29. Statistical assessment of normality - Resource internalization potential (difficulty)

	Original distributions		Transformed distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.000	.000	.010
Shapiro Wilk statistic (sig.)	.000	.000	.000	.009

A reiterative visual inspection of the newly formed histograms recognizes improvements in the variables' deviation from normality. The assertion is supported by both the K-S and S-W test in the 195 case dataset where the first is now significant at the .05 level while the second only marginally at the .01 level. No statistical test improvements are registered for the 360 case dataset.

Cooptation Potential

With regard to the cooptation potential variable, the associated original histograms (Figure B-50) reveal the presence of only limited positive skewness (principally in the 360 case dataset).

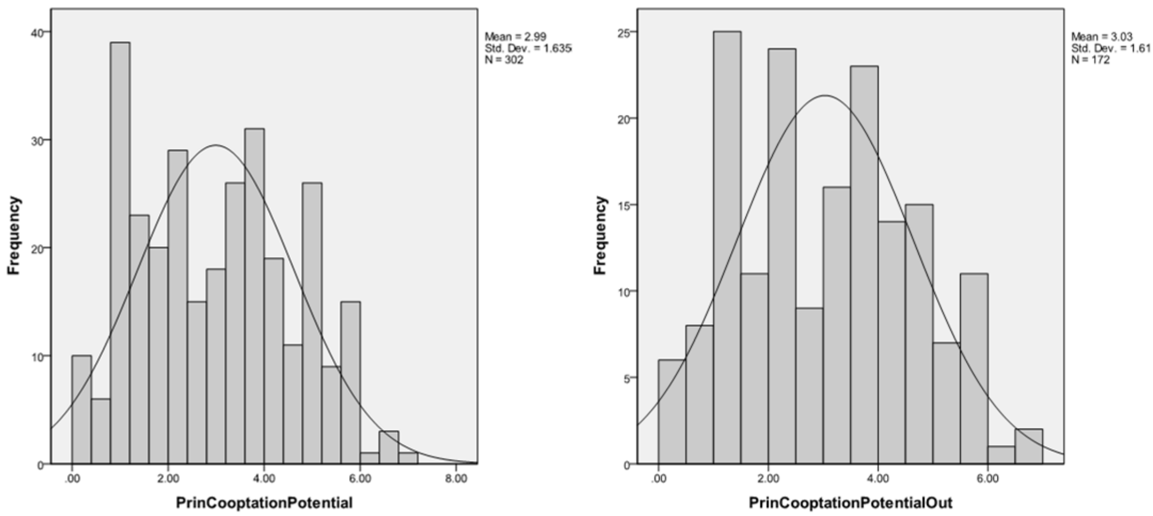


Figure B-50. Cooptation potential variable original histograms (left: 360 case dataset; right: 195 case dataset)

Table B-30. Statistical assessment of normality - Cooptation potential

	Original distributions		Transformed distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.000	no transformations or outlier removals applied	
Shapiro Wilk statistic (sig.)	.000	.001		

Initial visual inspections do not detect significant deviations from normality in either dataset. The assessment is limitedly supported only by the S-W test in the 195 case dataset (found significant at the .01 level) (Table B-30). The initial assessment did not detect any outliers or extreme values. Given the limited presence of skewness, no transformations are applied to the variables. As such, they remain for input into regression analysis techniques as they are.

Agent Actual Dependence

Finally, with regard to the agents actual dependence variable (operationalized through the principals' input to the agents' business), the associated original histograms (Figure B-51) reveal the presence of severe positive skewness combined with kurtotic tendencies. Initial visual inspections detect significant deviations from normality in both datasets; an assessment concurred by both the K-S and S-W test statistics (found to be significant at the .001 level) (Table B-31).

Given the presence of severe skewness, two data transformation tactics were considered (the square root and logarithmic function options) but only one was finally employed on the basis of data point retention. In other words, given the already precarious state of the variable in terms of missing values, the transformation that led to a larger number of data points being preserved was elected. As such, square root transformations were applied to the variables. Figure B-52 presents the variables' distributions after the relevant transformations.

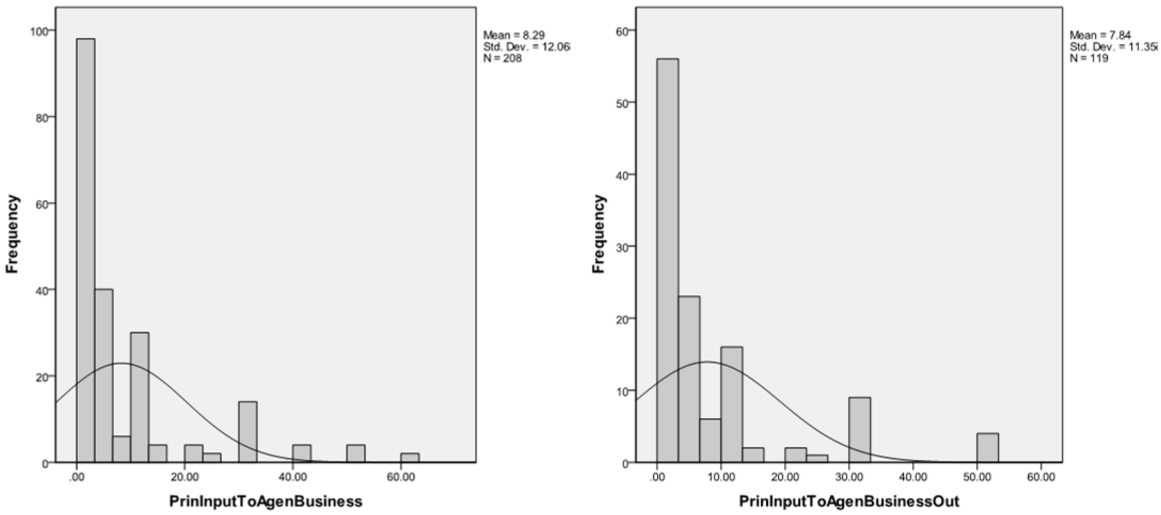


Figure B-51. Agent actual dependence variable original histograms (left: 360 case dataset; right: 195 case dataset)

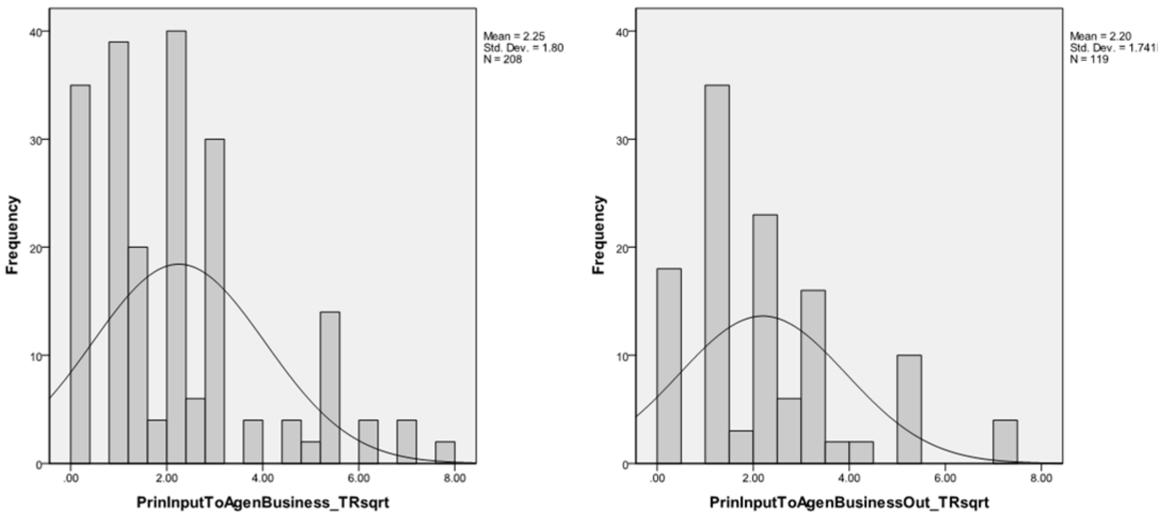


Figure B-52. Agent actual dependence variable histograms after transformations (left: 360 case dataset; right: 195 case dataset)

Table B-31. Statistical assessment of normality - Agent actual dependence (Princ. input to agents' business)

	Original distributions		Transformed distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.000	.000	.000
Shapiro Wilk statistic (sig.)	.000	.000	.000	.000

A reiterative visual inspection of the newly formed histograms recognizes significant improvements in the variables' deviation from normality. The assertion, however is not supported by the relevant statistical tests as both the K-S and S-W statistics are still significance at the .001 level in both datasets.

B.2.3 Competence-based variable data screening

Having concluded the screening process for the dependency-based variables, focus is now put on the variables associated with competence considerations. Primarily, the components of the contribution to higher gains variable are considered (i.e. the contribution to higher willingness-to-pay and higher perceived benefits variables).

Resource Value – Contribution to higher gains

With regard to the resource contribution to higher willingness-to-pay variable, the associated original histograms (Figure B-53) reveal the limited presence of positive skewness in both datasets. Initial visual inspections detect significant deviations from normality; an assessment concurred by both the K-S and S-W test statistics (found to be significant at the .001 level) (Table B-32). Given that the variable is not meant for direct input in either multiple linear regression or logistic regression analysis, the application of any transformations or outlier removals is not considered. Such actions are taken into consideration at the level of the composite contribution to higher gains variable.

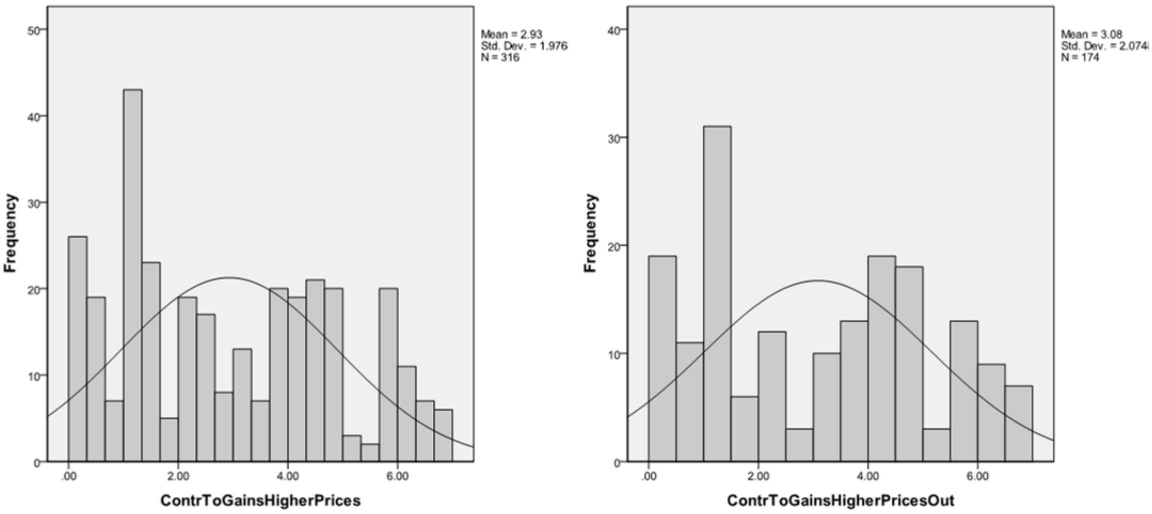


Figure B-53. Contribution to higher willingness-to-pay variable original histograms (left: 360 case dataset; right: 195 case dataset)

Table B-32. Statistical assessment of normality - Contribution to higher willingness-to-pay

	Original distributions		Transformed distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.000	no transformations or outlier removals applied	
Shapiro Wilk statistic (sig.)	.000	.000		

Focus is then put on the other forming variable of contribution to higher gains, being the contribution to higher perceived benefits variable. The associated original histograms (Figure B-54) do not reveal the presence of a particual type of skewness with limited positive kurtosis observed. Initial visual inspections do not detect significant deviations from normality; an assessment, however, not supported by the relevant K-S and S-W test statistics (found to be significant at the .001 level) (Table B-33).

As with the previous variable examined, no transformations or outlier removals are considered given the variable's component status. As such, focus is subsequently put on the formed variable of contribution to higher gains.

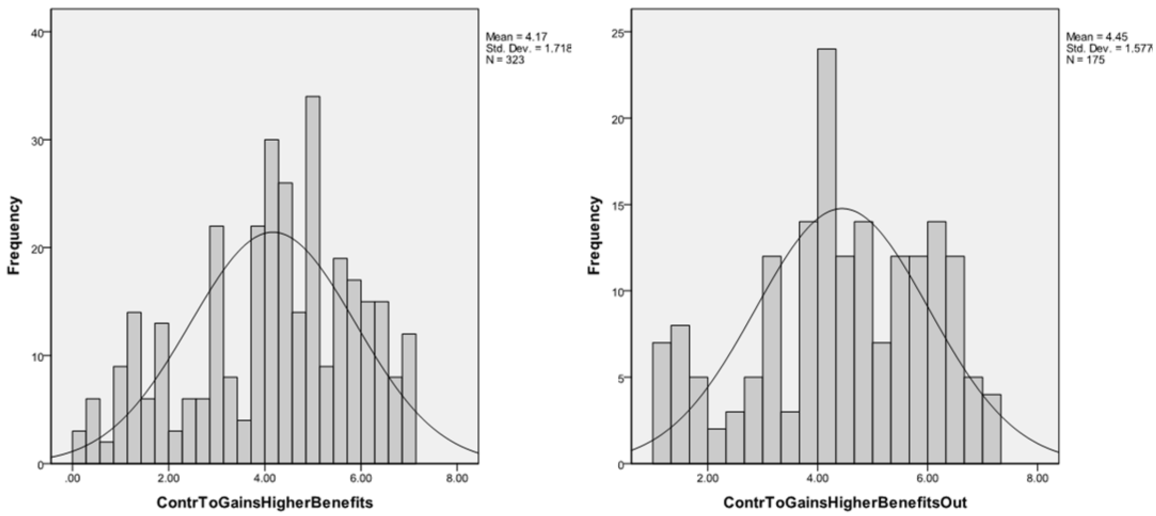


Figure B-54. Contribution to higher perceived benefits variable original histograms (left: 360 case dataset; right: 195 case dataset)

Table B-33. Statistical assessment of normality - Contribution to higher perceived benefits

	Original distributions		Transformed distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.000	no transformations or outlier removals applied	
Shapiro Wilk statistic (sig.)	.000	.000		

With regard to the contribution to higher gains variable (operationalized through the sum of contributions to higher willingness-to-pay and higher perceived benefits), the associated original histograms (Figure B-55) do not reveal the presence of any specific kind of skewness. Initial visual inspections do not detect significant deviations from normality in either dataset. The assessment is limitedly supported only by the K-S test in the 195 case dataset (found significant at the .01 level) (Table B-34). The initial assessment did not detect any outliers or extreme values. Given the limited presence of skewness, no transformations are applied. As such, the variable remains for input into regression analysis techniques as is.

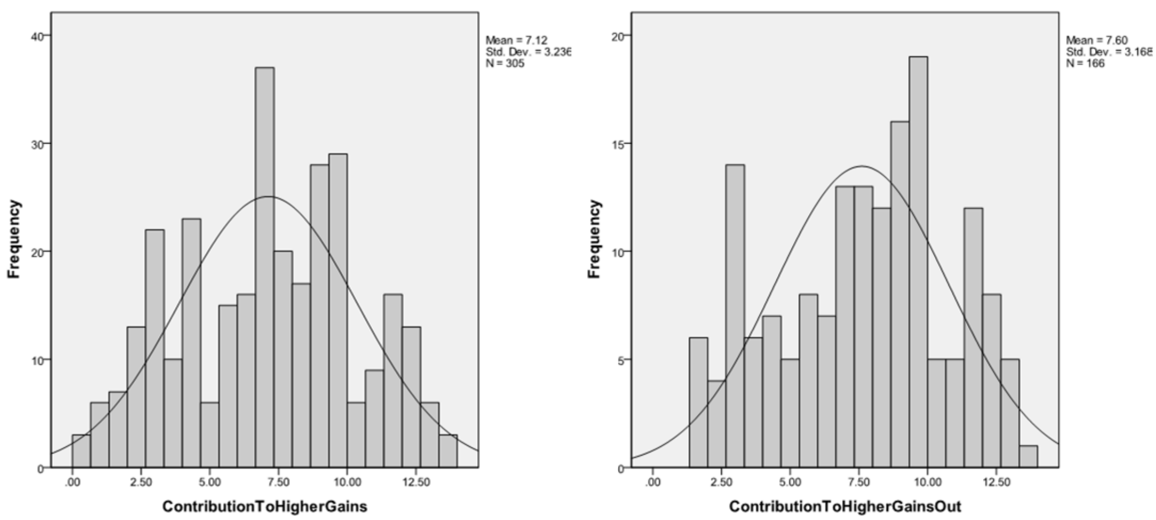


Figure B-55. Contribution to higher gains variable original histograms (left: 360 case dataset; right: 195 case dataset)

Table B-34. Statistical assessment of normality - Contribution to higher gains (higher wtp + higher benefits)

	Original distributions		Transformed distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.003	no transformations or outlier removals applied	
Shapiro Wilk statistic (sig.)	.000	.000		

Resource Value – Contribution to lower costs

With regard to the contribution to lower costs variable (operationalized through the allowance to compete on costs), the associated original histograms (Figure B-56) do not reveal the presence of any particular type of skewness. Initial visual inspections do not detect significant deviations from normality in either dataset. The assessment is limitedly supported by the K-S test in the 195 case dataset (found significant at the .01 level) (Table B-35). The initial assessment detected five low outliers in both datasets. Given the absence of skewness, no transformations are applied. Figure B-57 presents the variables' distributions after the removal of outliers.

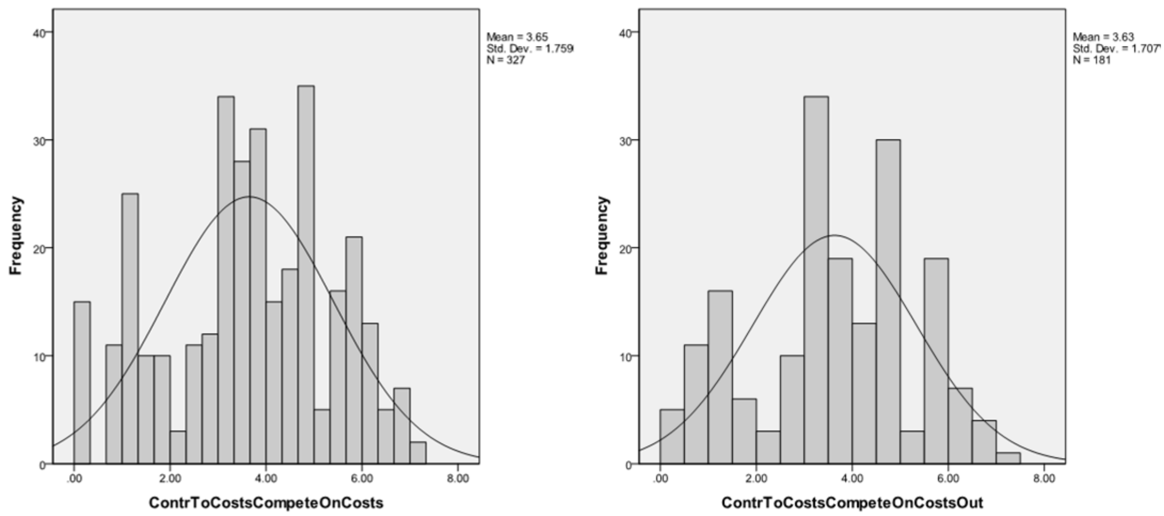


Figure B-56. Contribution to lower costs variable original histograms (left: 360 case dataset; right: 195 case dataset)

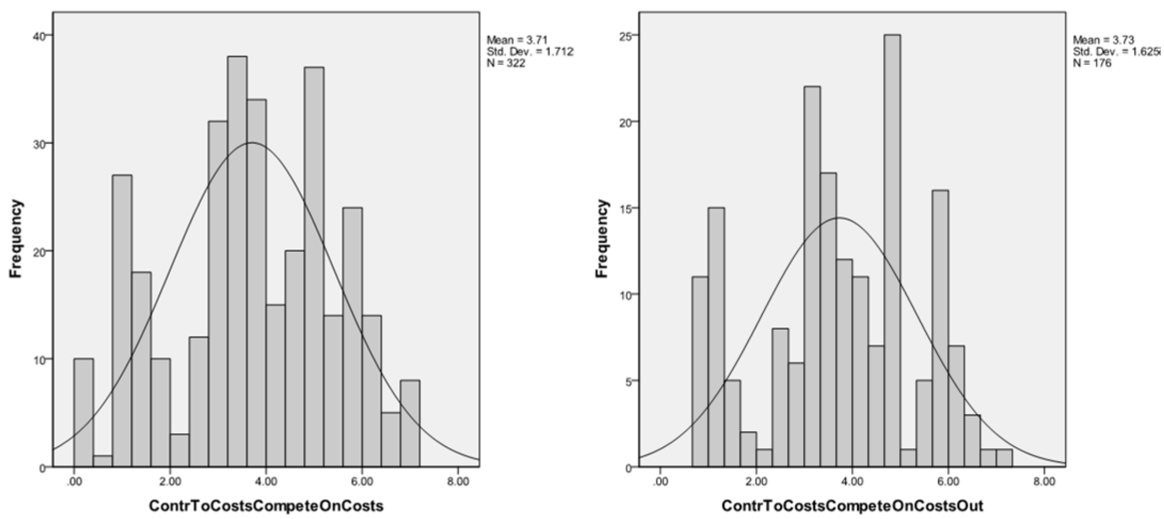


Figure B-57. Contribution to lower costs variable histograms after outlier removal (left: 360 case dataset; right: 195 case dataset)

Table B-35. Statistical assessment of normality - Contribution to lower costs (allowance to compete on costs)

	Original distributions		Transformed distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.003	.001	.005
Shapiro Wilk statistic (sig.)	.000	.000	.000	.000

A reiterative visual inspection of the newly formed histograms verifies the initial findings of no major deviations from normality in both datasets. The outlier removal process led to an improvement of the K-S tests in both datasets. In the 360 case dataset, the associated statistic is no longer found to be significant at the .001 level, while further improvement is observed in the same statistic's significance levels in the 195 case dataset.

Potential Resource Value

In succession, the components of the potential resource value variable are considered (i.e. the potential contribution to higher willingness-to-pay and the potential contribution to lower costs).

With regard to the potential contribution to higher willingness-to-pay variable, the associated original histograms (Figure B-58) reveal the presence of some positive skewness in both datasets. Initial visual inspections detect significant deviations from normality; an assessment concurred by both the K-S and S-W test statistics (found to be significant at the .001 level) (Table B-36). Given that the variable is not meant for direct input in either multiple linear regression or logistic regression analysis, the application of any transformations or outlier removals is not considered. Rather, such actions are taken into consideration at the level of the composite potential resource value variable.

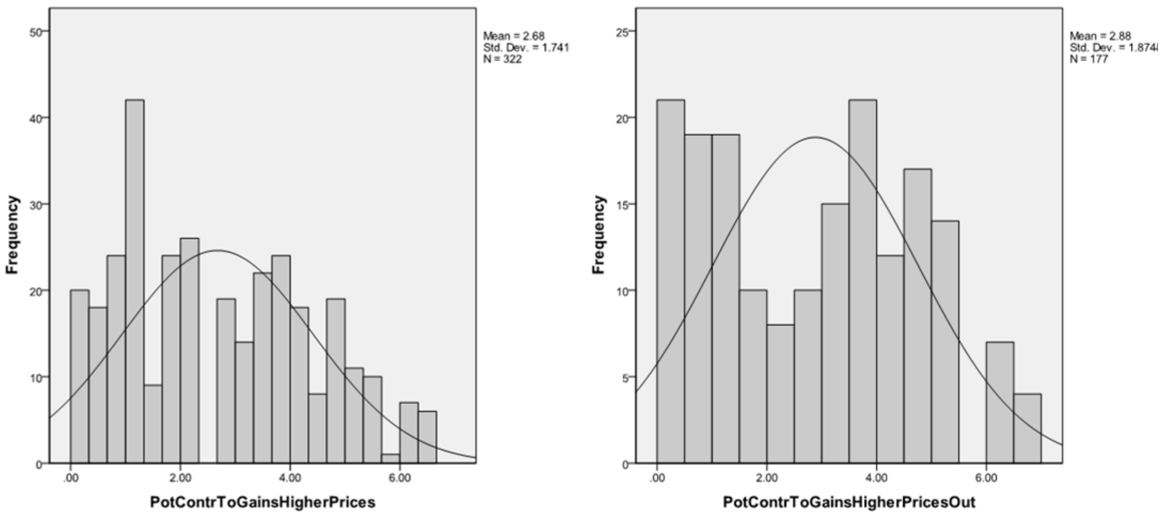


Figure B-58. Potential contribution to higher willingness-to-pay variable original histograms (left: 360 case dataset; right: 195 case dataset)

Table B-36. Statistical assessment of normality - Potential contribution to higher willingness-to-pay

	Original distributions		Transformed distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.000	no transformations or outlier removals applied	
Shapiro Wilk statistic (sig.)	.000	.000		

As such, focus is then put on the other forming variable of potential resource value, which is the potential contribution to lower costs (operationalized as the potential allowance to compete on costs). The variable's associated original histograms (Figure B-59) do not reveal the presence of any particual type of skewness. Initial visual inspections do not detect significant deviations from normality; an assessment however, not entirely supported by the relevant K-S and S-W test statistics. In the 360 case dataset, both tests' statistics are found to be significant at the .001 level while in the 195 case dataset the K-S statistic is significant only at the .01 level (Table B-37).

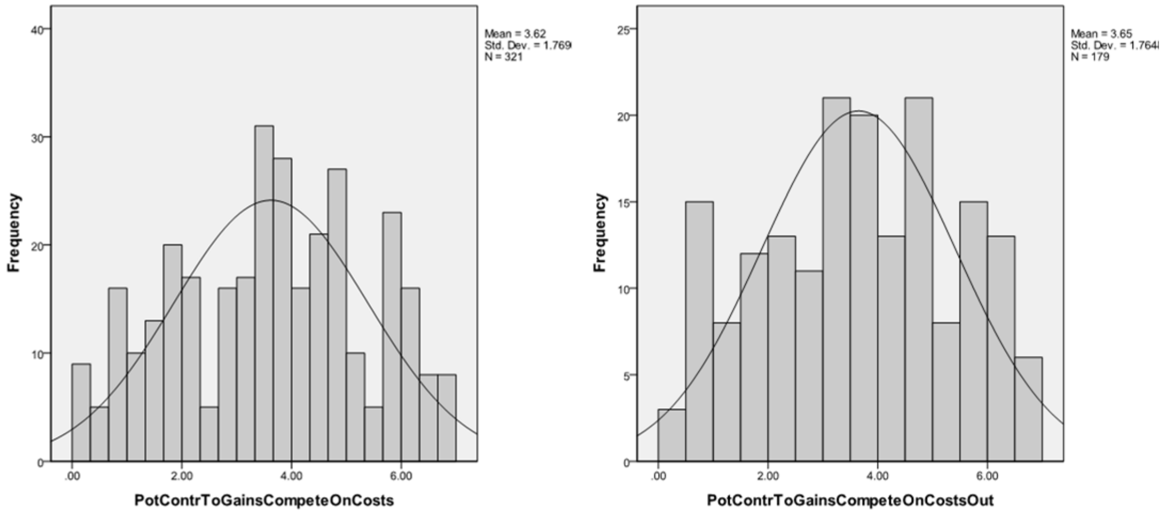


Figure B-59. Potential contribution to lower costs variable original histograms (left: 360 case dataset; right: 195 case dataset)

Table B-37. Statistical assessment of normality - Potential contribution to lower costs

	Original distributions		Transformed distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.008	no transformations or outlier removals applied	
Shapiro Wilk statistic (sig.)	.000	.000		

As with the previous variable examined, no transformations or outlier removals are considered given the variable's component status. As such, focus is subsequently put on the formed variable of potential resource value.

With regard to the potential resource value variable (operationalized through the sum of potential contributions to higher willingness-to-pay and potential contributions to lower costs), the associated original histograms (Figure B-60) do not reveal the presence of any specific kind of skewness with only limited kurtotic tendencies present. Initial visual inspections do not detect significant deviations from normality in either dataset. The assessment is generously supported by the Kolmogorov-Smirnov test whose statistic is found to marginally be significant at the .05 level in the 360 case dataset while being not significant at all at the same level in the 195 case dataset (Table B-38). The initial assessment did not detect any outliers or extreme values. Given the limited presence of skewness, no transformations are applied. As such, the variable remains for input into regression analysis techniques as is.

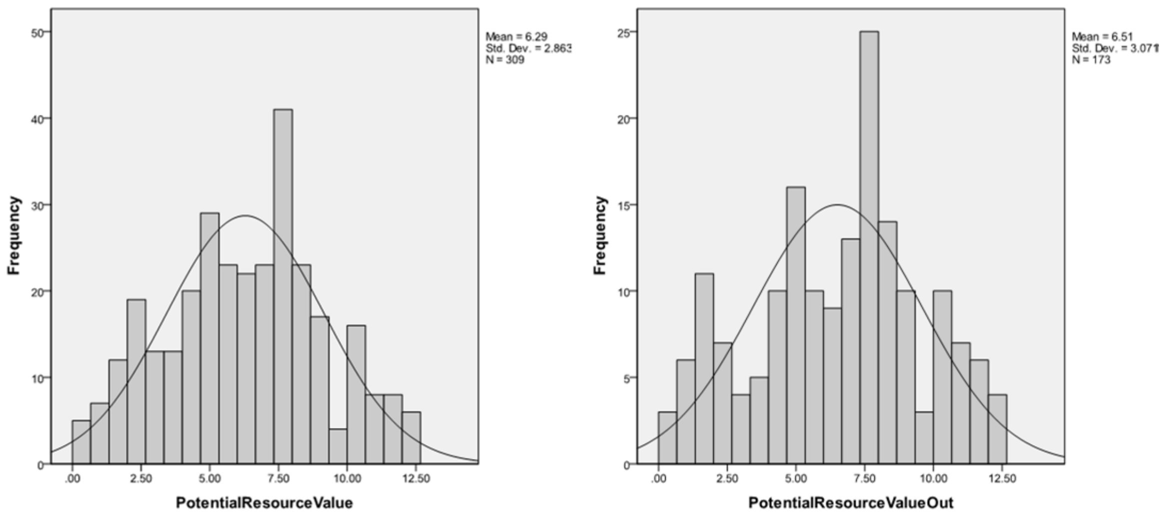


Figure B-60. Potential resource value variable original histograms
(left: 360 case dataset; right: 195 case dataset)

Table B-38. Statistical assessment of normality - Potential resource value (pot. higher wtp + pot. lower costs)

	Original distributions		Transformed distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.030	.065	no transformations or outlier removals applied	
Shapiro Wilk statistic (sig.)	.003	.003		

Natural Resource Scarcity

With regard to the natural resource scarcity variable (operationalized through recruitment difficulty), the associated historgrams (Figure B-61) reveal the presence of limited skewness only in the 360 case dataset. Initial visual inspections do not detect significant deviations from normality in either dataset. The assessment, as far as the 195 case dataset is concerned, is generously supported by the K-S test whose statistic is not found to be significant at all (Table B-39). In the 360 case dataset, however, the relevant tests' statistics remain significant at the .001 level. The initial assessment did not detect any outliers or extreme values. Given the limited presence of skewness, no transformations are applied. As such, the variable remains for input into regression analysis techniques as is.

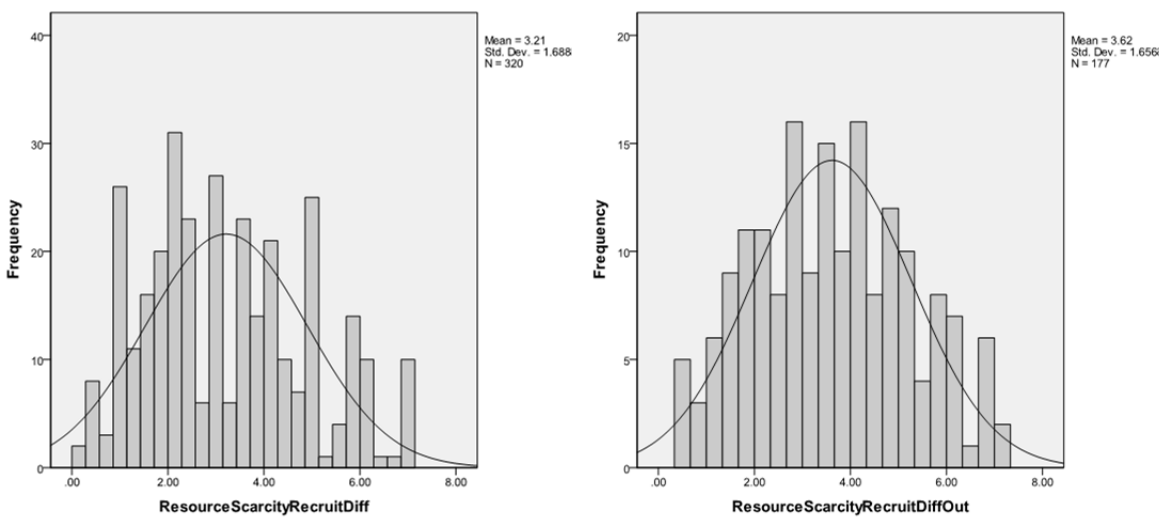


Figure B-61. Natural resource scarcity variable original histograms
(left: 360 case dataset; right: 195 case dataset)

Table B-39. Statistical assessment of normality - Natural resource scarcity (recruitment difficulty)

	Original distributions		Transformed distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.200	no transformations or outlier removals applied	
Shapiro Wilk statistic (sig.)	.000	.011		

Resource Inimitability – Intrafirm causal ambiguity

Continuing the screening process for the competence-based variables, focus is put the components of the resource inimitability construct. Specifically, emphasis is currently placed on the forming components of the intrafirm causal ambiguity attribute of resource inimitability (i.e. resource complexity, tacitness and distance to performance).

With regard to the resource complexity variable, the associated histograms (Figure B-62) do not reveal the presence of skewness in either dataset. Initial visual inspections do not detect significant deviations from normality; an assessment concurred by both the K-S and S-W test statistics within both datasets. In the 360 case dataset the K-S statistic is significant at the .05 level while the S-W respective statistic is marginally found significant at the .01 level (Table B-40). In the 195 case dataset both tests' statistics are significant only at the .05 level. Given that the variable is not meant for direct input in either multiple linear regression or logistic regression analysis, the application of any transformations or outlier removals is not considered. Rather, such actions are taken into consideration at the level of the composite intrafirm causal ambiguity variable.

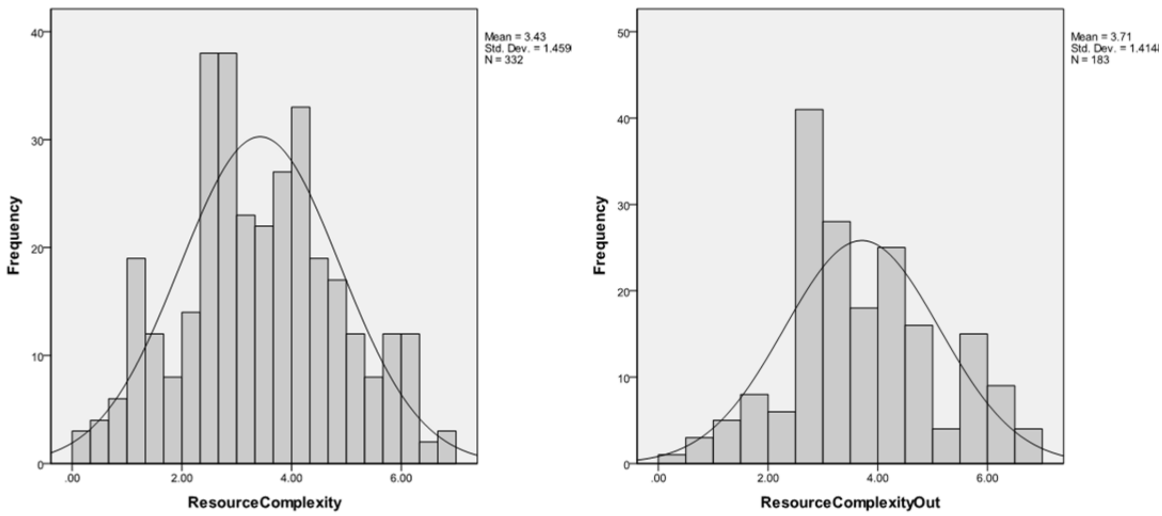


Figure B-62. Resource complexity variable original histograms (left: 360 case dataset; right: 195 case dataset)

Table B-40. Statistical assessment of normality - Resource complexity (complexity of tasks included)

	Original distributions		Transformed distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.010	.028	no transformations or outlier removals applied	
Shapiro Wilk statistic (sig.)	.008	.016		

As such, focus is then put on the second forming variable of intrafirm causal ambiguity, which is resource tacitness (operationalized as the perceived undefinedness of tasks included in an activity). The variable's associated original histograms (Figure B-63) reveal the presence of some positive skewness only in the 360 case dataset. Initial visual inspections detect noticeable deviations from normality in the 360 case dataset but only limitedly so in the 195 case dataset.

The assessment is supported by the relevant K-S and S-W test statistics. In the 360 case dataset, both tests' statistics are found to be significant at the .001 level while in the 195 case dataset the K-S statistic is found not to be significant even at the .05 level (Table B-41). As with the previous variable examined, no transformations or outlier removals are considered given the variable's component status. As such, focus is subsequently put on the third forming variable of intrafirm causal ambiguity, which is the resource distance to performance attribute.

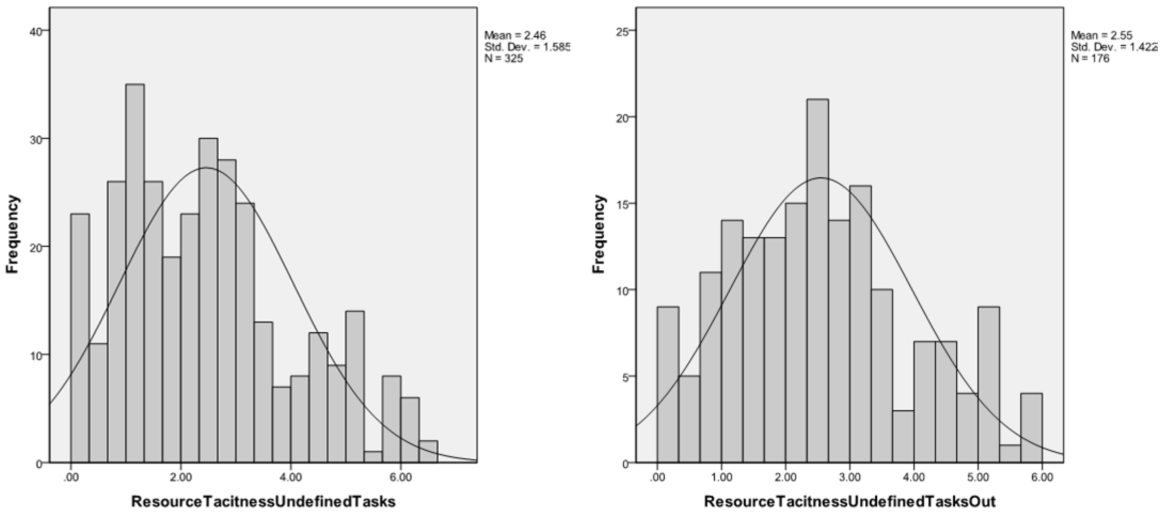


Figure B-63. Resource tacitness variable original histograms (left: 360 case dataset; right: 195 case dataset)

Table B-41. Statistical assessment of normality - Resource tacitness (undefinedness of tasks included)

	Original distributions		Transformed distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.200	no transformations or outlier removals applied	
Shapiro Wilk statistic (sig.)	.000	.004		

With regard to the resource distance to performance variable (operationalized as the perceived invisibility of an activity in corporate measures of performance), the associated histograms (Figure B-64) reveal only some limited positive skewness.

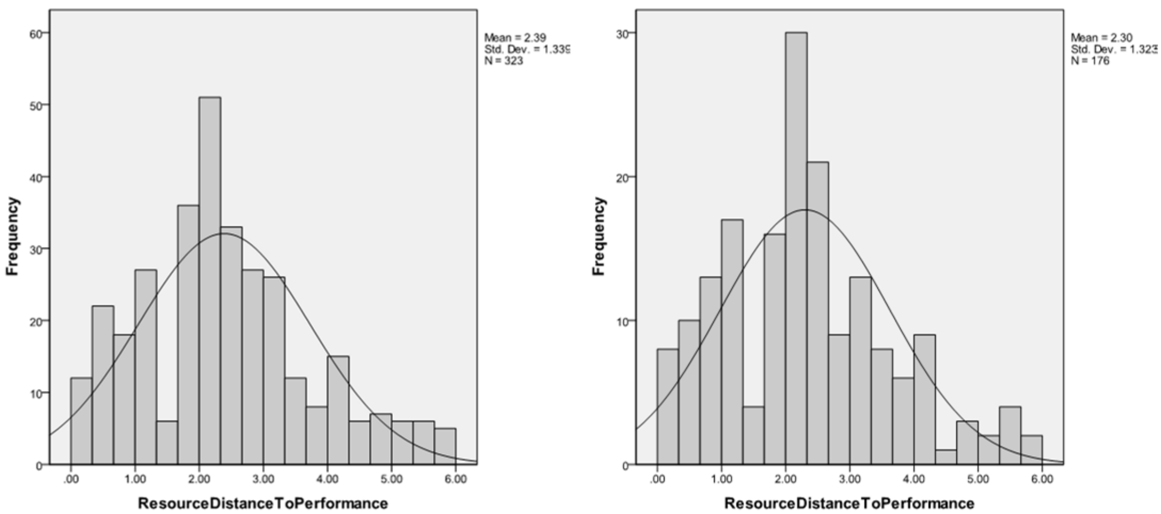


Figure B-64. Resource distance to performance variable original histograms (left: 360 case dataset; right: 195 case dataset)

Table B-42. Statistical assessment of normality - Resource distance to performance (activity invisibility)				
	Original distributions		Transformed distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.007	no transformations or outlier removals applied	
Shapiro Wilk statistic (sig.)	.000	.000		

Initial visual inspections detect some deviation from normality in both datasets (yet limitedly so in the 195 case dataset). The assessment is concurred by both the K-S and S-W test statistics within each dataset (Table B-42). In the 195 case dataset both tests' statistics are significant only at the .05 level. As with the previous two variables examined no transformations or outlier removals are considered here, given the variable's component status. As such, focus is finally put on the formed variable itself, in essence intrafirm causal ambiguity.

With regard to the intrafirm causal ambiguity variable (operationalized as the sum of resource complexity, tacitness and distance to performance), the associated histograms (Figure B-65) reveal the presence of kurtotic tendencies in both datasets with no discernible skewness present in either one of them. Initial visual inspections do not detect significant deviations from normality in either dataset (bar the aforementioned kurtotic tendencies). The assessment is limitedly supported by both the K-S and S-W tests in the 195 case dataset (both found significant at the .01 rather than the .001 level) (Table B-43). The initial assessment did not detect any outliers or extreme values. Given the absence of skewness, no transformations are applied. As such, the variable remains for input into regression analysis techniques as is.

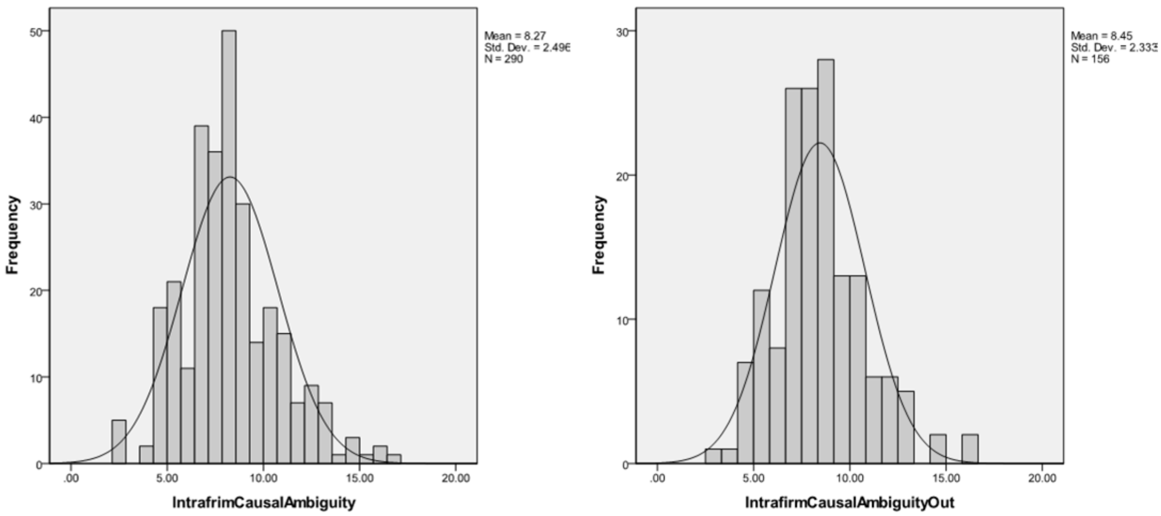
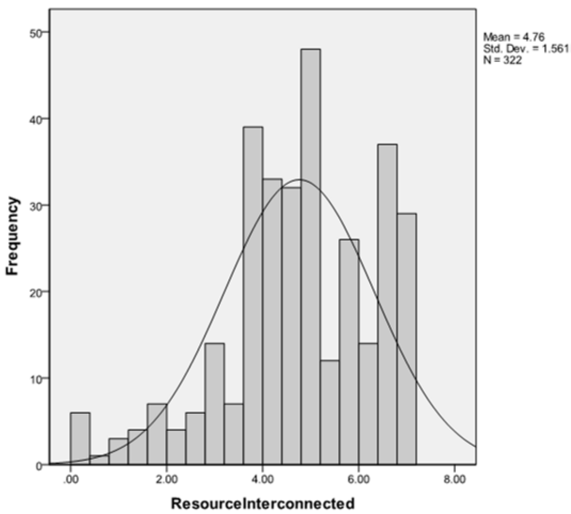


Figure B-65. Intrafirm causal ambiguity variable original histograms
(left: 360 case dataset; right: 195 case dataset)

Table B-43. Statistical assessment of normality - Intrafirm causal ambiguity (complex. + tacitness + distance)				
	Original distributions		Transformed distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.003	no transformations or outlier removals applied	
Shapiro Wilk statistic (sig.)	.000	.001		

Resource Inimitability – Interfirm causal ambiguity

Moving on to the second focal construct of resource inimitability, that is interfirm casual ambiguity, reference is made with regard to the variable of resource interconnectedness. The variable's associated histograms (Figure B-66) reveal the presence of some negative skewness in both datasets. Initial visual inspections detect some deviation from normality in the 360 case dataset (while only limitedly so in the 195 case dataset). The assessment is concurred by both the K-S and S-W test statistics within each dataset. In the 360 case dataset both tests' statistics are significant at the .001 level while in the 195 case dataset the K-S statistic is significant at the .01 level (Table B-44). At this point, an argument is made towards the preservation of the particular variable's distributions as they are (i.e. with no transformations applied) even with the presence of noticeable negative skewness. The reasoning behind this suggestion is that the only regression technique that manifestly demands normality is multiple linear regression. The 195 case dataset (for which indications of normality are at least present) is the only one slated for this particular regression technique. As such, whether the 360 case dataset conforms to normality assumptions is practically irrelevant. Given the aforementioned argumentation, the variable's distributions are maintained as is.



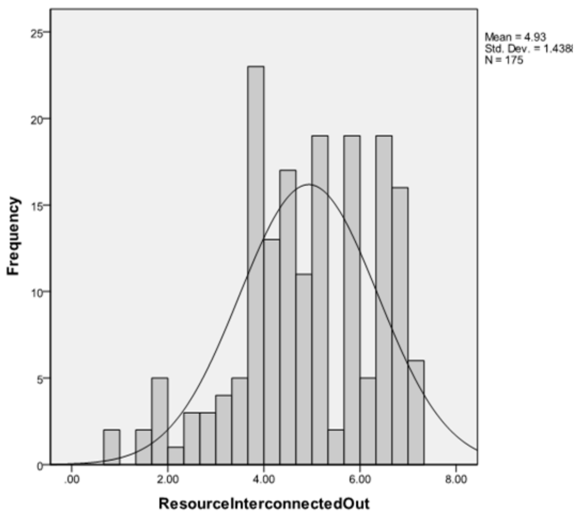


Figure B-66. Resource interconnectedness variable original histograms (left: 360 case dataset; right: 195 case dataset)

Table B-44. Statistical assessment of normality - Interfirm causal ambiguity (resource interconnectedness)

	Original distributions		Transformed distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.004	no transformations or outlier removals applied	
Shapiro Wilk statistic (sig.)	.000	.000		

Resource Inimitability – Social complexity

Concluding finally the competence-based variables, reference is made with regard to the third attributive construct of resource inimitability, resource social complexity.

With regard to the resource social complexity variable, the associated histograms (Figure B-67) reveal the presence of extreme negative skewness exacerbated by the presence of a number of extreme values in both datasets. Initial visual inspections detect severe violations of normality in both datasets. The assessment is wholly supported by both the K-S and S-W tests in both datasets (all statistics found significant at the .001 level) (Table B-45). The initial assessment detected 15 high extreme values in the 360 case dataset and 9 high extreme values in the 195 case dataset. Given the manifest presence of skewness (which is nonetheless alleviated with the removal of extreme values), square root transformations are applied to the variables. Figure B-68 presents the variables' distributions after the removal of outliers and the application of the relevant transformations.

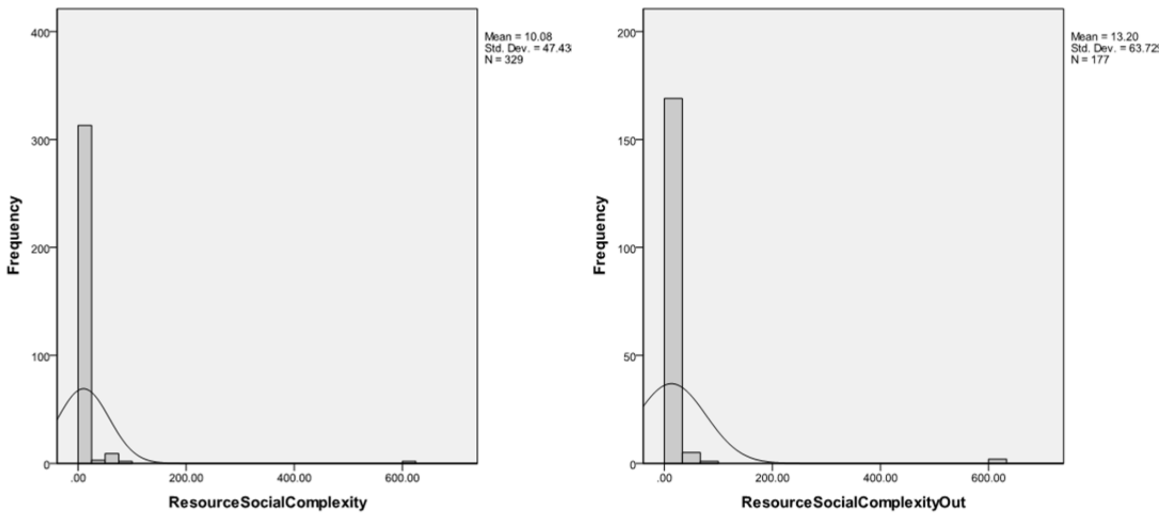


Figure B-67. Resource social complexity variable original histograms (left: 360 case dataset; right: 195 case dataset)

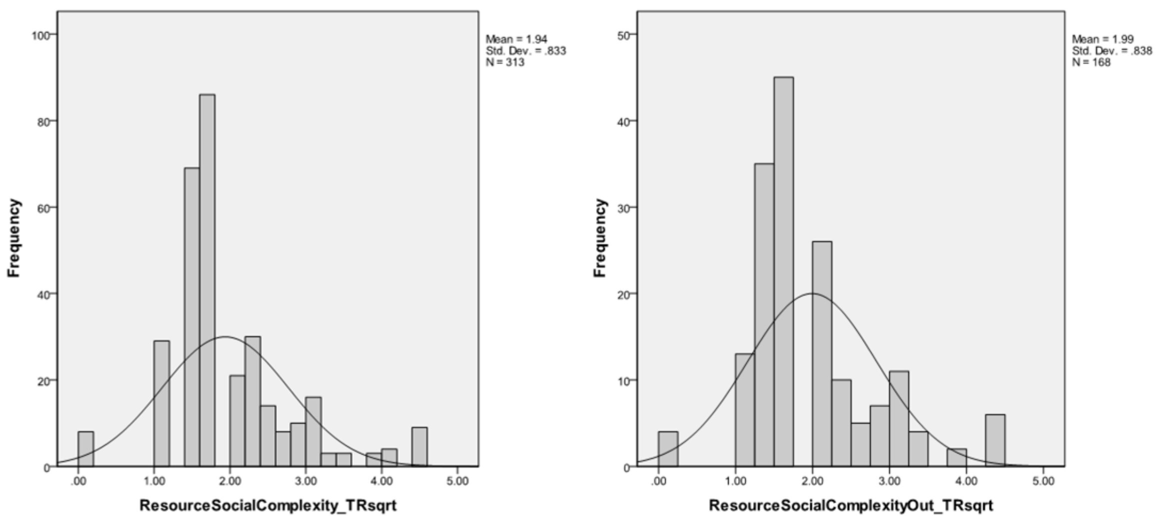


Figure B-68. Resource social complexity variable histograms after transformations (left: 360 case dataset; right: 195 case dataset)

Table B-45. Statistical assessment of normality - Resource social complexity

	Original distributions		Pruned & transf. distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.000	.000	.000
Shapiro Wilk statistic (sig.)	.000	.000	.000	.000

A reiterative visual inspection of the newly formed histograms recognizes tremendous improvement in the variables' deviation from normality. The same assertion, however, cannot be supported by the relevant statistical estimates. Both the K-S and S-W tests remain significant at the .001 level even after the transformations.

B.2.4 Identity-based variable data screening

Having concluded the screening process for the comptence-based variables, focus is now put on the variables associated with identity considerations. The three relevant constructs, operationalized in turn by three respective variables, are resource-identity coherece, institutional forces influence and industrial forces influence.

Resource-Identity Coherence

With regard to the resource-identity coherence variable, the associated original histograms (Figure B-69) reveal the presence of limited negative skewness in both datasets. Initial visual inspections argue for reasonable conformity to normality assumptions in both datasets. The assessment, however, is not supported by either the K-S or S-W test in either dataset as the relevant statistics are all found significant at the .001 level (Table B-46). The initial assessment detected five low outliers in both the 360 as well as the 195 case dataset. Given the diminutive presence of skewness (which is partially alleviated with the removal of outliers), no particular data transformations are applied. Figure B-70 presents the variables' distributions after the removal of outliers.

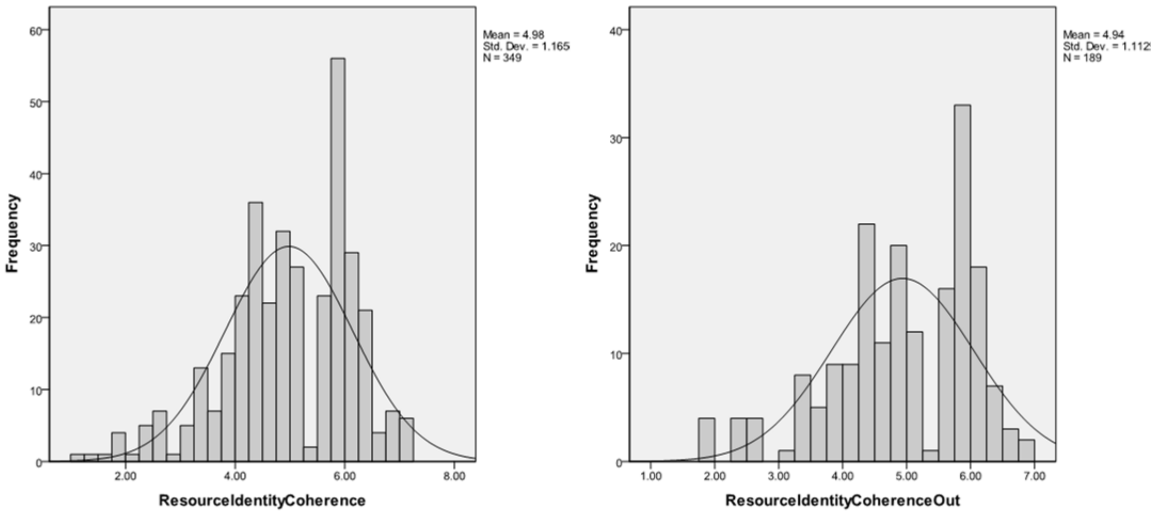


Figure B-69. Resource-identity coherence variable original histograms (left: 360 case dataset; right: 195 case dataset)

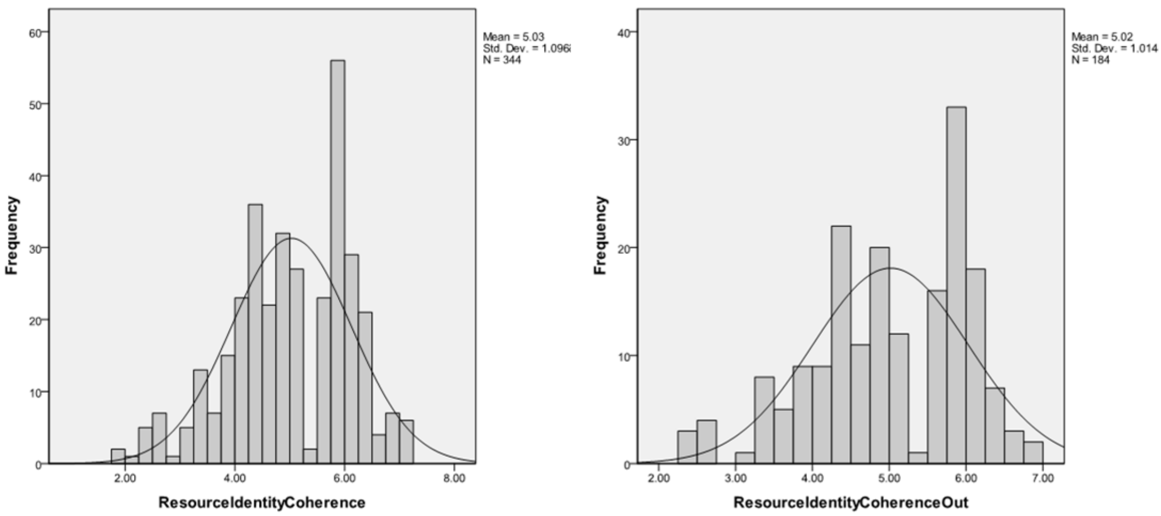


Figure B-70. Resource-identity coherence variable histograms after outlier removal (left: 360 case dataset; right: 195 case dataset)

Table B-46. Statistical assessment of normality - Resource-identity coherence

	Original distributions		Pruned distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.000	.000	.000
Shapiro Wilk statistic (sig.)	.000	.000	.000	.000

A reiterative visual inspection of the newly formed histograms still argues for acceptable levels of normality present in the datasets; an assessment still not portrayed in the relevant statistics tests. Both the K-S and S-W tests remain significant at the .001 level even after the removal of outliers. At this point, it is recognized that the screening effort could opt for the reflection and subsequent square root transformation of the variable in search for better conformity with a normal distribution. Nevertheless, in the interest of interpretation simplicity, this avenue is not followed.

Institutional Forces Influence

With regard to the institutional forces influence variable, the associated histograms (Figure B-71) do not reveal the presence of a particular kind of skewness in either dataset, while some kurtotic tendencies are recognized in both datasets. Initial visual inspections argue for reasonable conformity to normality assumptions in both datasets. The assessment, however, is not supported by either the K-S or S-W test in either dataset as the relevant statistics are all found significant at the .001 level (Table B-47). The initial assessment did not detect the presence of outliers or extreme values in either dataset. Given the absence of particular skewness, no data transformations are applied. As such, the screening process argues for the variable's use in further analyses as is.

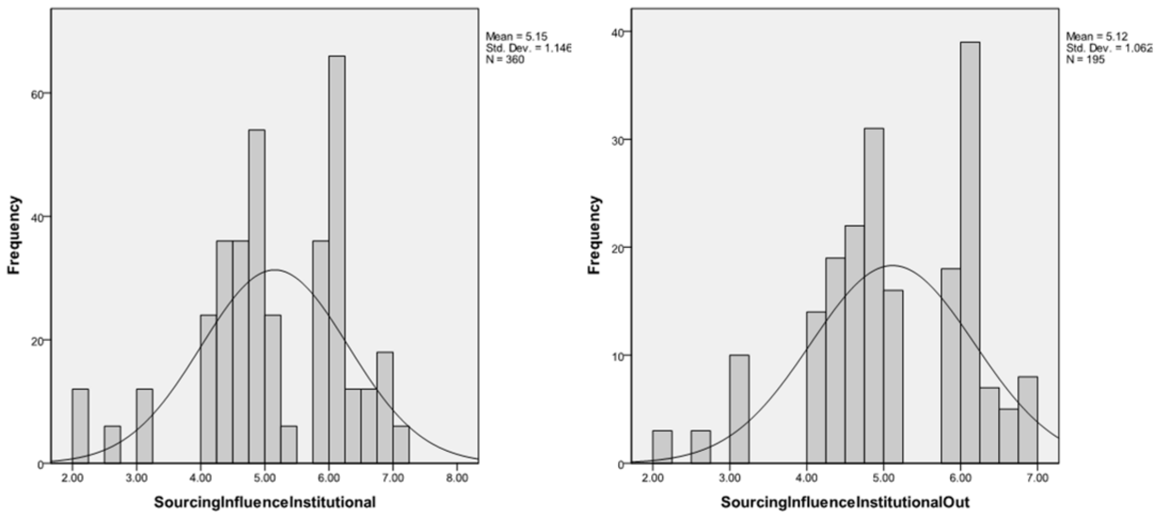


Figure B-71. Institutional forces influence variable original histograms (left: 360 case dataset; right: 195 case dataset)

Table B-47. Statistical assessment of normality - Institutional forces influence

	Original distributions		Pruned distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.000	no transformations or outlier removals applied	
Shapiro Wilk statistic (sig.)	.000	.000		

Institutional Forces Influence

Finally, with regard to the last identity-based variable, that of industrial forces influence, the associated histograms (Figure B-72) again do not reveal the presence of a particular kind of skewness in either dataset with only limited kurtosis being present. Initial visual inspections argue for reasonable conformity to normality assumptions in both datasets. The assessment is partially supported by the Kolmogorov-Smirnov test in both datasets as the test's relevant statistics are found to be significant only at the .01 level (Table B-48). The initial assessment did not detect the presence of outliers or extreme values in either dataset. Furthermore, given the absence of particular skewness, no data transformations are applied. As such, the screening process argues for the variable's use in further analyses as is.

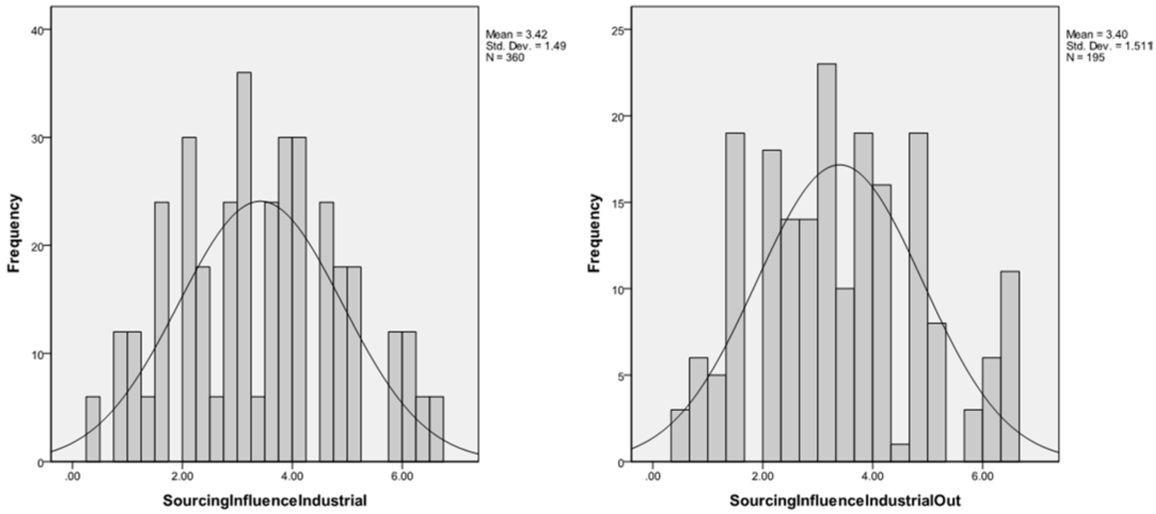


Figure B-72. Industrial forces influence variable original histograms (left: 360 case dataset; right: 195 case dataset)

Table B-48. Statistical assessment of normality - Industrial forces influence

	Original distributions		Pruned distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.001	.001	no transformations or outlier removals applied	
Shapiro Wilk statistic (sig.)	.000	.001		

B.2.5 Dependent and control variable data screening

Having concluded the screening process for all of the hypothesized independent variables, focus is now put on the study's dependent and control variables. Starting with the focal dependent variable of activity outsourcing, the associated histograms (Figure B-73) reveal the presence of extreme positive skewness combined with major kurtotic tendencies. Initial visual inspections detect significant deviations from normality in both datasets; an assessment concurred by both the K-S and S-W test statistics (found to be significant at the .001 level) (Table B-49).

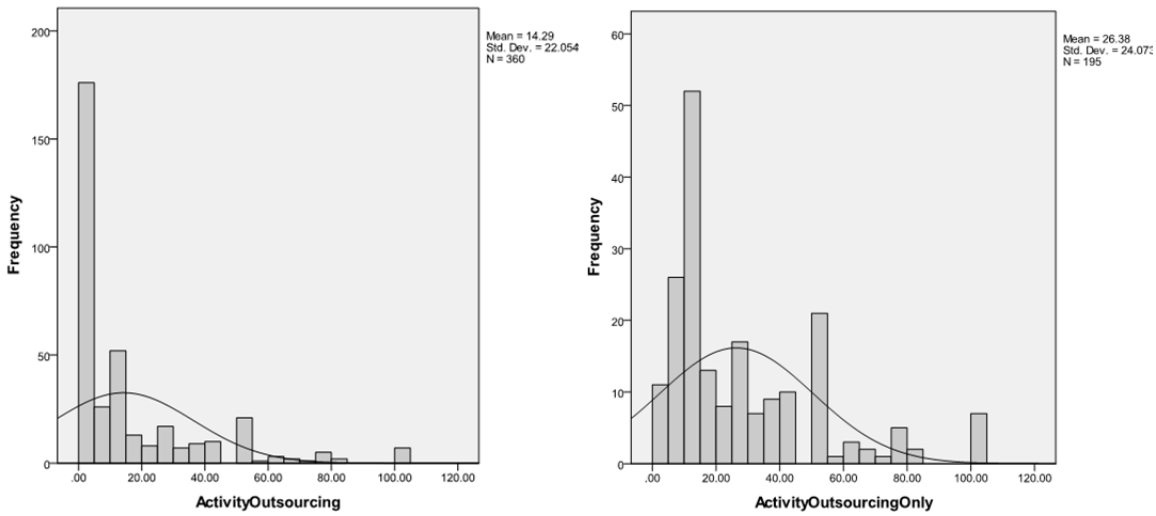


Figure B-73. Activity outsourcing level dependent variable original histograms (left: 360 case dataset; right: 195 case dataset)

As the specific variable acts as the study's dependent outcome, treatments are considered with each intended analysis technique's particulars in mind. As such, in the 195 case dataset (slated for multiple linear regression) the variable retains its status as a continuous variable and is transformed through a logarithmic function with a base of 10. In the 360 case dataset (intended for logistic regression) the variable is transformed into a categorical variable with two states (1.00: activity not outsourced; 2.00: activity outsourced to any degree). Figure B-74 presents the variables' distributions after the relevant transformations.

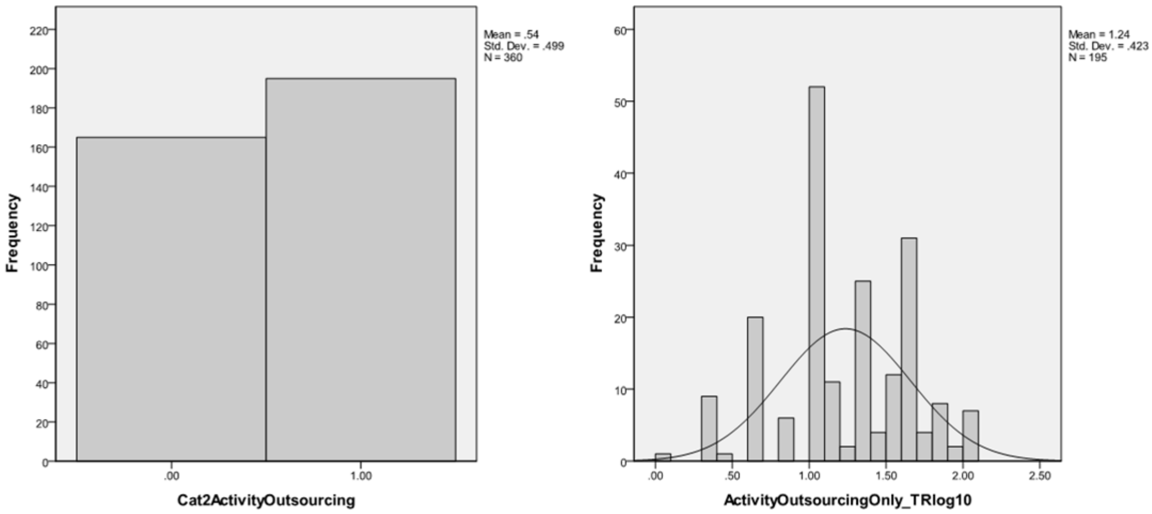


Figure B-74. Activity outsourcing level dependent variable histograms after transformations (left: 360 case dataset; right: 195 case dataset)

Table B-49. Statistical assessment of normality - Activity outsourcing level

	Original distributions		Transformed distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.000	not applicable	.000
Shapiro Wilk statistic (sig.)	.000	.000		.000

Evidently, checking the 360 case dataset for normality is meaningless. As such, focus is put on the 195 case dataset's transformed activity outsourcing level variable. A reiterative visual inspection of the newly formed histogram argues for reasonable conformity to normality assumptions in the 195 case dataset, despite the continuing presence of kurtotic tendencies. The assessment is, rather expectedly, not supported by the associated K-S and S-W statistics test (both still found to be significant at the .001 level).

Firm Size

The firm size control construct is operationalized through four different alternative (and largely interchangeable) variables. These include: (1) the number of shipping firm employees on shore, (2) the number of firm employees at sea, (3) the number of ships owned or controlled and (4) the total ship DWT operated by the firm. With regard to the employees on shore variable, the associated histograms (Figure B-75) reveal the presence of extreme positive skewness and kurtosis; a distributional pattern that permeates virtually all manifestations of the firm size control construct. Initial visual inspections detect significant deviations from normality; an assessment concurred by both the K-S and S-W test statistics (found to be significant at the .001 level) (Table B-50). Given the presence of extreme positive skewness, the variable is transformed through a logarithmic function with a base of 10. Figure B-76 presents the variables' distributions after the relevant transformations.

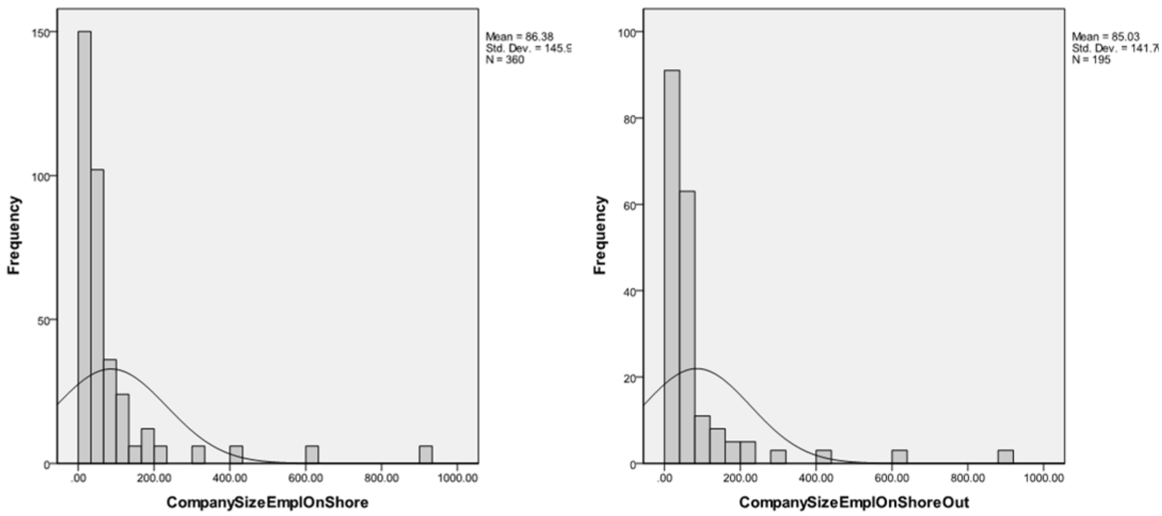


Figure B-75. Firm size (employees on shore) control variable original histograms (left: 360 case dataset; right: 195 case dataset)

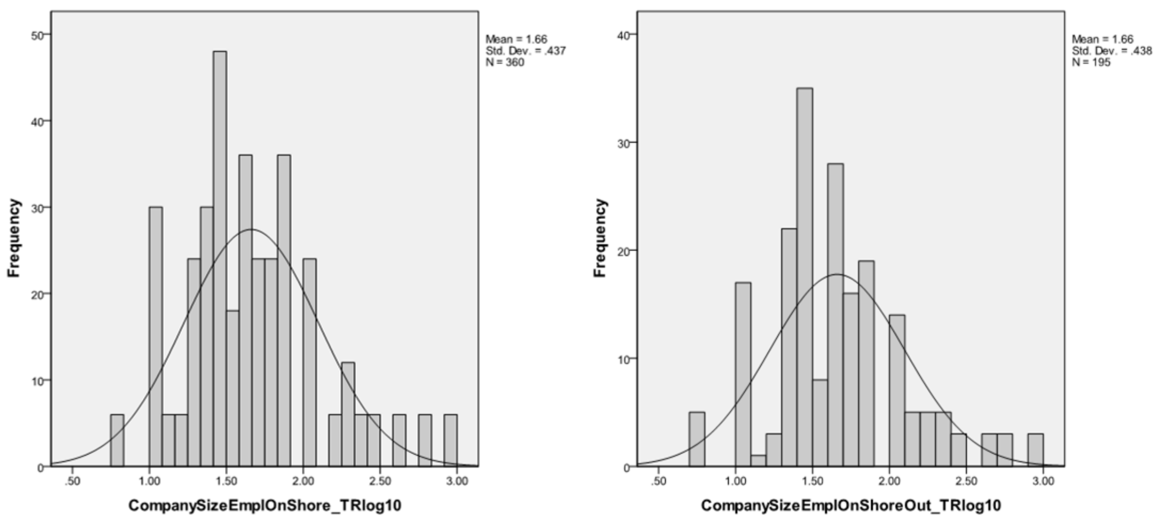


Figure B-76. Firm size (employees on shore) control variable histograms after transformations (left: 360 case dataset; right: 195 case dataset)

Table B-50. Statistical assessment of normality - Firm size (employees on shore)

	Original distributions		Transformed distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.000	.000	.000
Shapiro Wilk statistic (sig.)	.000	.000	.000	.000

A reiterative visual inspection of the newly formed histograms argues for acceptable levels of normality in the transformed variables; A proposition, nevertheless, not supported by the relevant statistics tests.

With regard to the employees at sea variable, the associated histograms (Figure B-77) again reveal the presence of extreme positive skewness and kurtosis in both datasets. As such, initial visual inspections detect significant deviations from normality; an assessment concurred by both the K-S and S-W test statistics (found to be significant at the .001 level) (Table B-51). Given the presence of extreme positive skewness, the variable is transformed through a logarithmic function with a base of 10. Figure B-78 presents the variables' distributions after the relevant transformations.

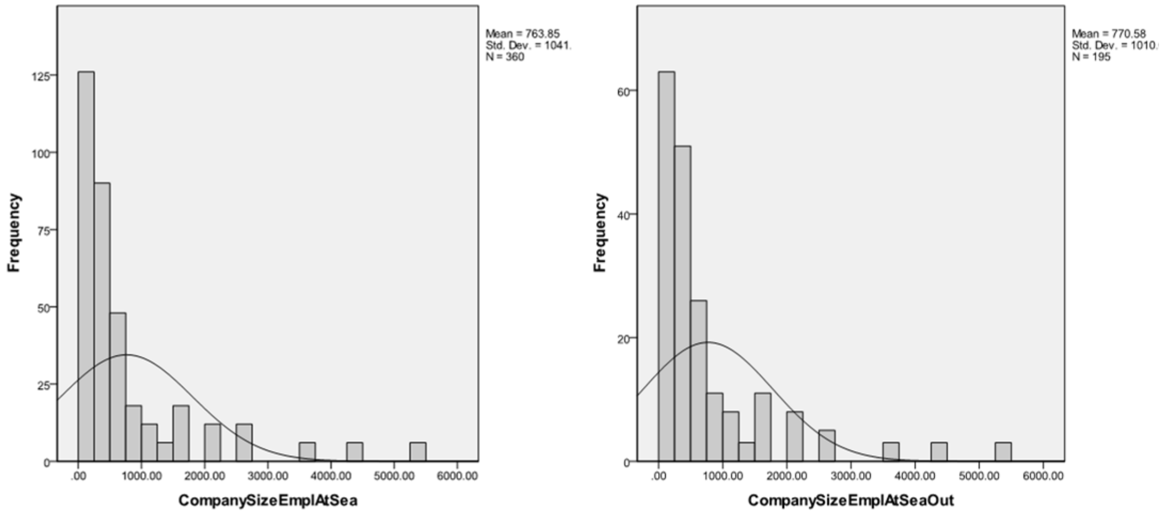


Figure B-77. Firm size (employees at sea) control variable original histograms (left: 360 case dataset; right: 195 case dataset)

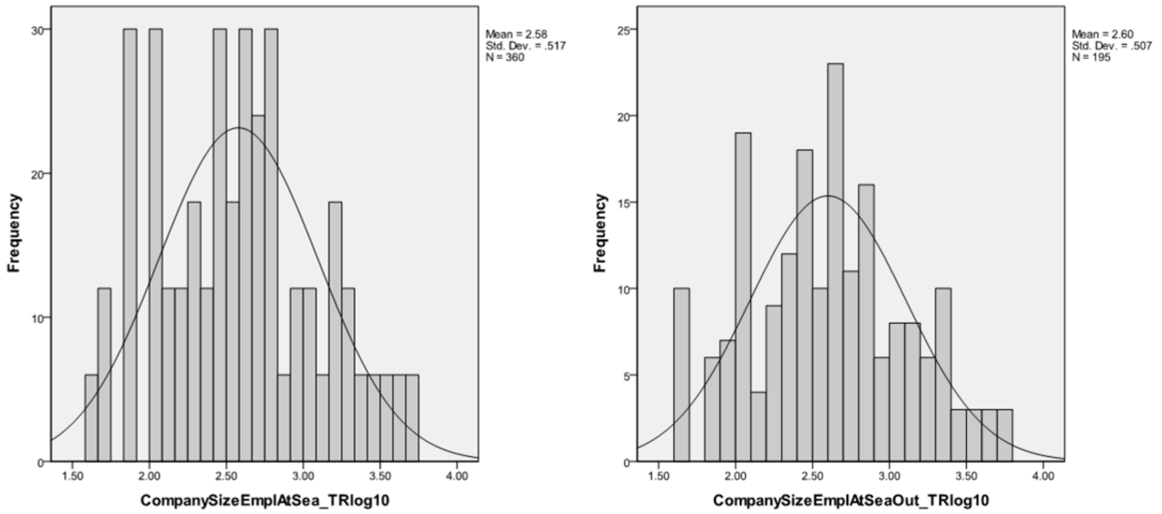


Figure B-78. Firm size (employees at sea) control variable histograms after transformations (left: 360 case dataset; right: 195 case dataset)

Table B-51. Statistical assessment of normality - Firm size (employees at sea)

	Original distributions		Transformed distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.000	.001	.063
Shapiro Wilk statistic (sig.)	.000	.000	.000	.017

A reiterative visual inspection of the newly formed histograms argues for acceptable levels of normality in the transformed variables. The proposition is supported by improvements in both the K-S and S-W tests, with the K-S statistic found not to be significant at the .05 level in the 195 dataset.

With regard to the number of ships variable, the associated histograms (Figure B-79) similarly reveal the presence of extreme positive skewness and kurtosis in both datasets. As such, initial visual inspections detect significant deviations from normality; an assessment concurred by both the K-S and S-W test statistics (found to be significant at the .001 level) (Table B-52). Given the presence of extreme positive skewness, the variable is transformed through a logarithmic function with a base of 10. Figure B-80 presents the variables' distributions after the relevant transformations.

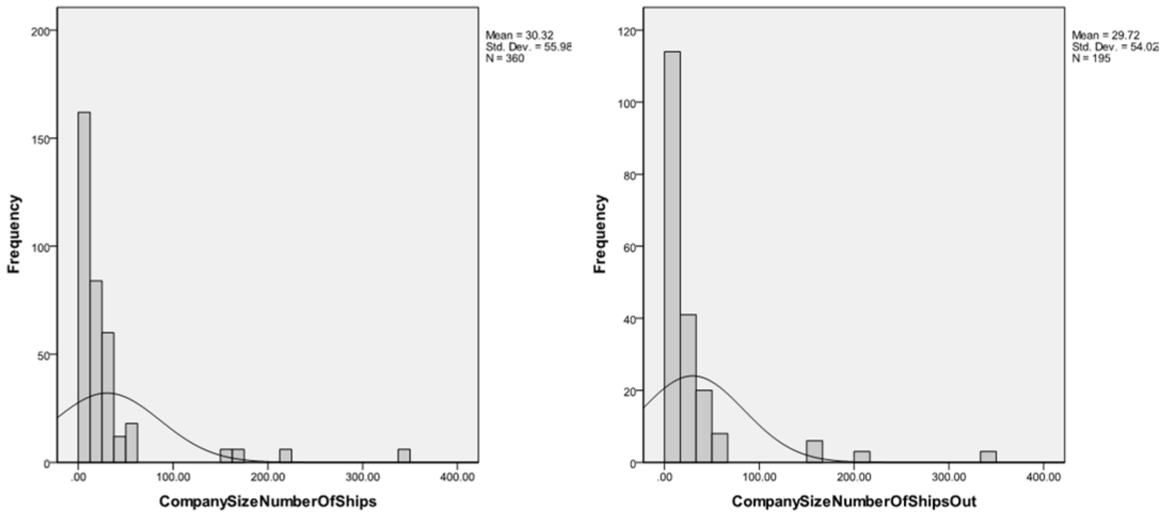


Figure B-79. Firm size (number of ships) control variable original histograms (left: 360 case dataset; right: 195 case dataset)

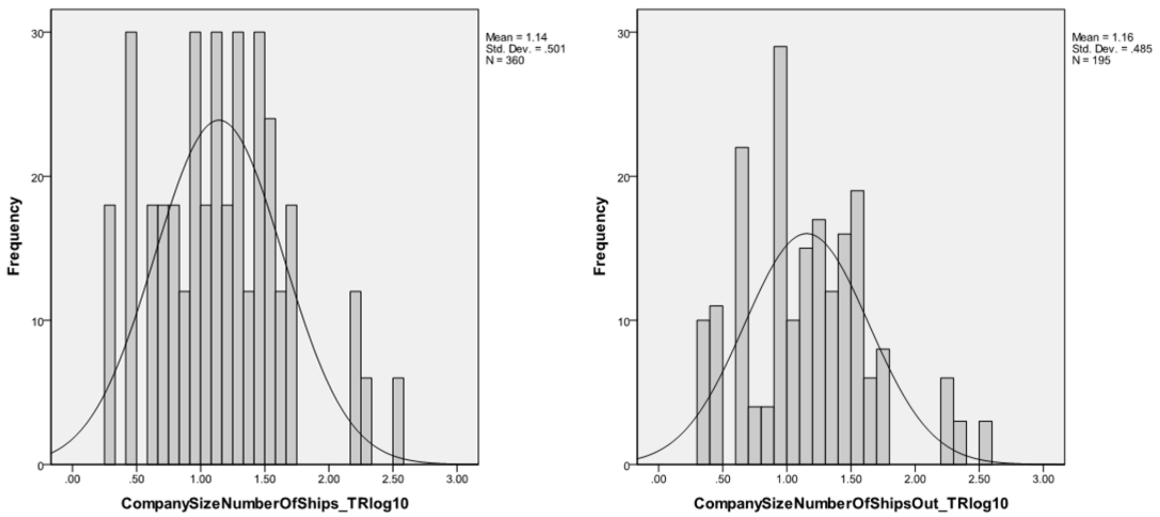


Figure B-80. Firm size (number of ships) control variable histograms after transformations (left: 360 case dataset; right: 195 case dataset)

Table B-52. Statistical assessment of normality - Firm size (number of ships)

	Original distributions		Transformed distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.000	.002	.006
Shapiro Wilk statistic (sig.)	.000	.000	.000	.000

A reiterative visual inspection of the newly formed histograms argues for acceptable levels of normality in the transformed variables. The proposition is supported by improvements in the K-S test for both datasets (statistics found to be significant only at the .01 level).

Finally, with regard to the total ship DWT variable, the associated histograms (Figure B-81) once more reveal the presence of extreme positive skewness and kurtosis in both datasets. As such, initial visual inspections detect significant deviations from normality; an assessment concurred by both the K-S and S-W test statistics (found to be significant at the .001 level) (Table B-53). Given the presence of extreme positive skewness, the variable is transformed through a logarithmic function with a base of 10. Figure B-82 presents the variables' distributions after the relevant transformations.

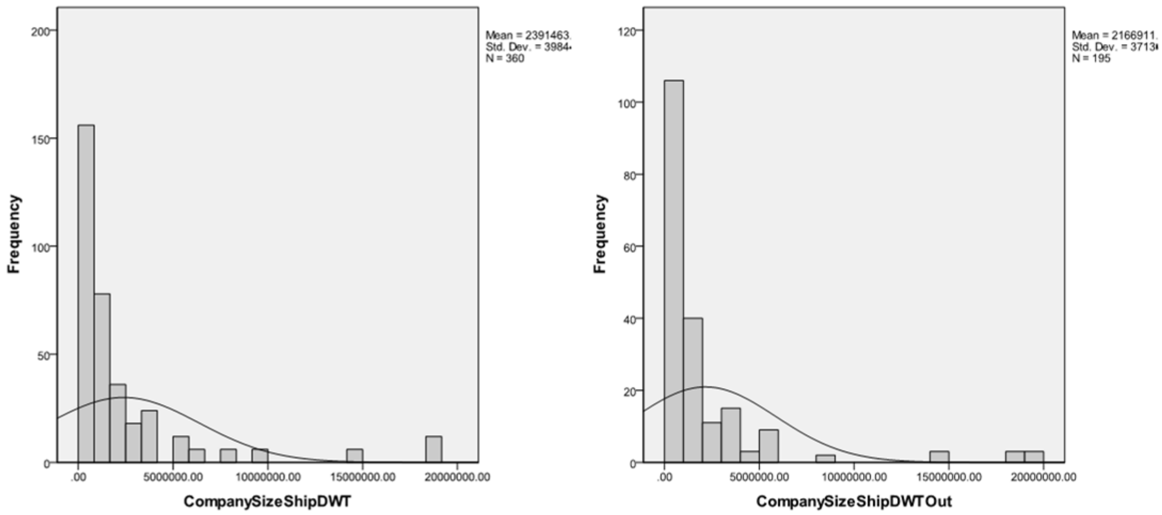


Figure B-81. Firm size (total ship DWT) control variable original histograms (left: 360 case dataset; right: 195 case dataset)

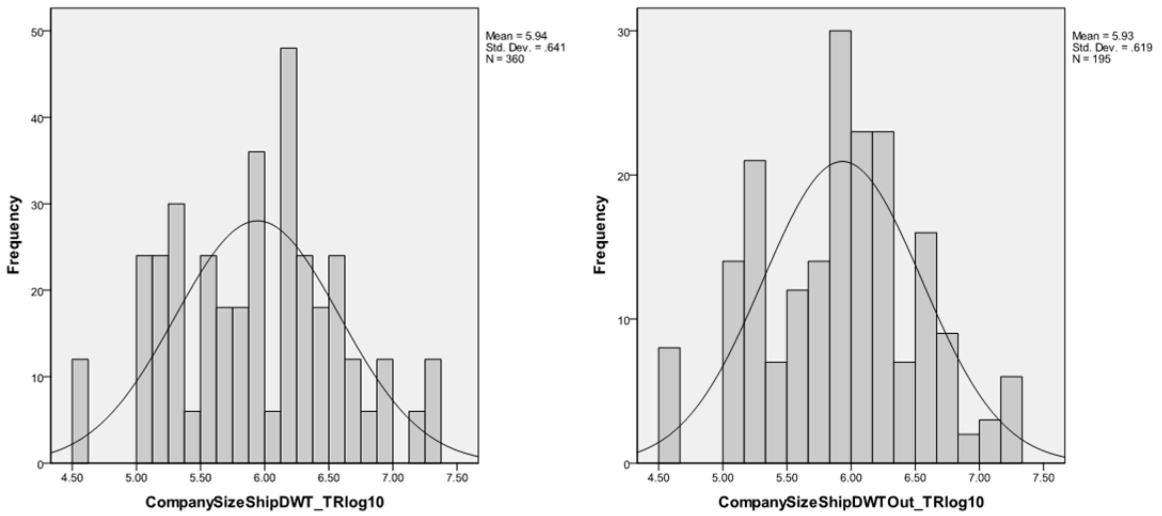


Figure B-82. Firm size (total ship DWT) control variable histograms after transformations (left: 360 case dataset; right: 195 case dataset)

A reiterative visual inspection of the newly formed histograms argues for acceptable levels of normality in the transformed variables. The proposition is supported by improvements in both the K-S and S-W tests in the 195 case dataset (statistics found to be significant at the .01 and .05 levels).

Table B-53. Statistical assessment of normality - Firm size (total ship DWT)

	Original distributions		Transformed distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.000	.000	.003
Shapiro Wilk statistic (sig.)	.000	.000	.000	.012

Firm Age

With regard to the firm age variable, the associated histograms (Figure B-83) reveal considerable positive skewness and kurtosis in both datasets. Initial visual inspections, thus, detect deviations from normality; an assessment concurred by both the K-S and S-W test statistics (both found significant at the .001 level) (Table B-54). Given the observed skewness, square root transformations are applied. Figure B-84 presents the variables' distributions after the relevant transformations.

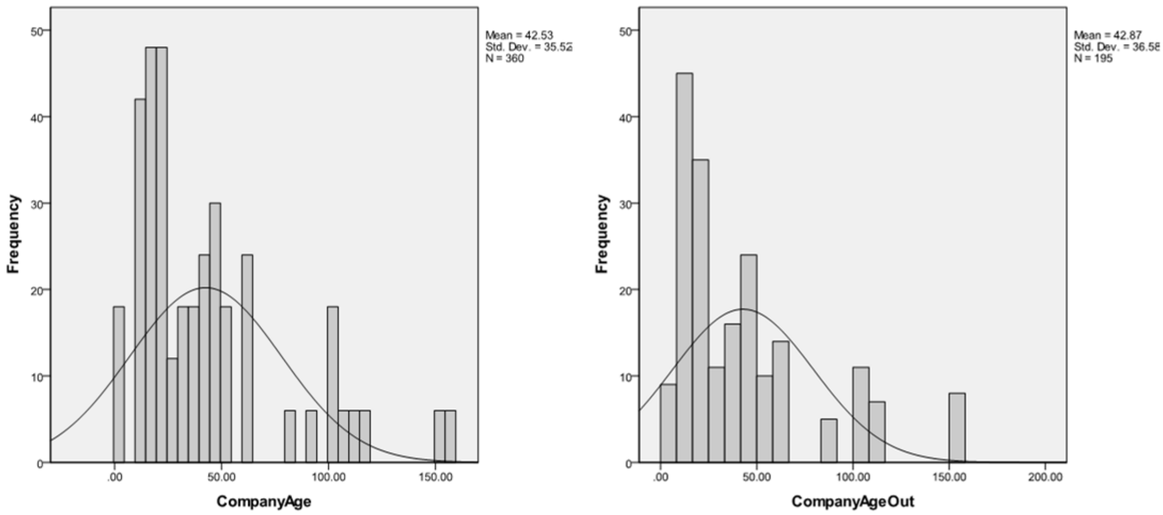


Figure B-83. Firm age (years in business) control variable original histograms (left: 360 case dataset; right: 195 case dataset)

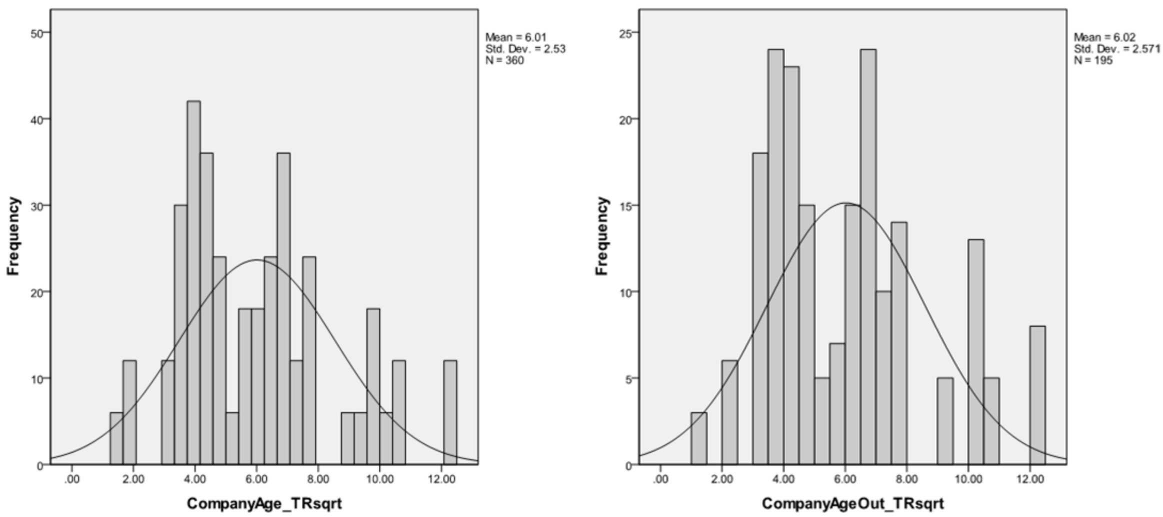


Figure B-84. Firm age (years in business) control variable histograms after transformations (left: 360 case dataset; right: 195 case dataset)

Table B-54. Statistical assessment of normality - Firm age (years in business)

	Original distributions		Transformed distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.000	.000	.000
Shapiro Wilk statistic (sig.)	.000	.000	.000	.000

A reiterative visual inspection of the newly formed histograms argues for acceptable levels of normality in the transformed variables. The proposition, however, is not supported by the K-S and S-W tests, as their statistics remain significant at the .001 levels in both datasets.

Average Ship Age

With regard to the average ship age variable, finally, the associated histograms (Figure B-85) reveal some positive skewness and kurtosis in both datasets. Deviations from normality are thus observed; an assessment concurred by the K-S and S-W test statistics (found significant at the .001 level) (Table B-55). Given the observed skewness, square root transformations are applied. Figure B-86 presents the variables' distributions after the relevant transformations.

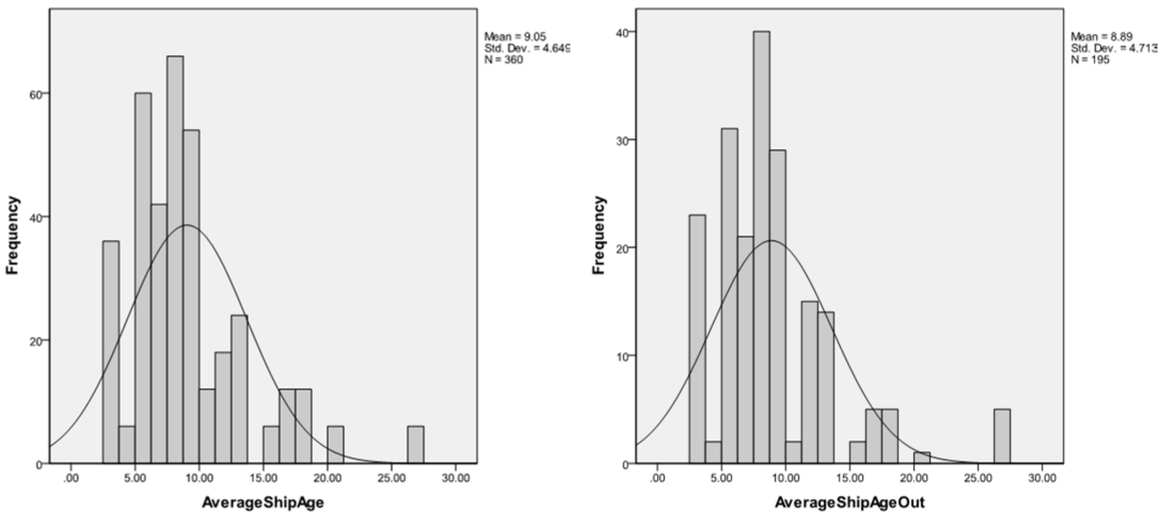


Figure B-85. Firm average ship age (years) control variable original histograms (left: 360 case dataset; right: 195 case dataset)

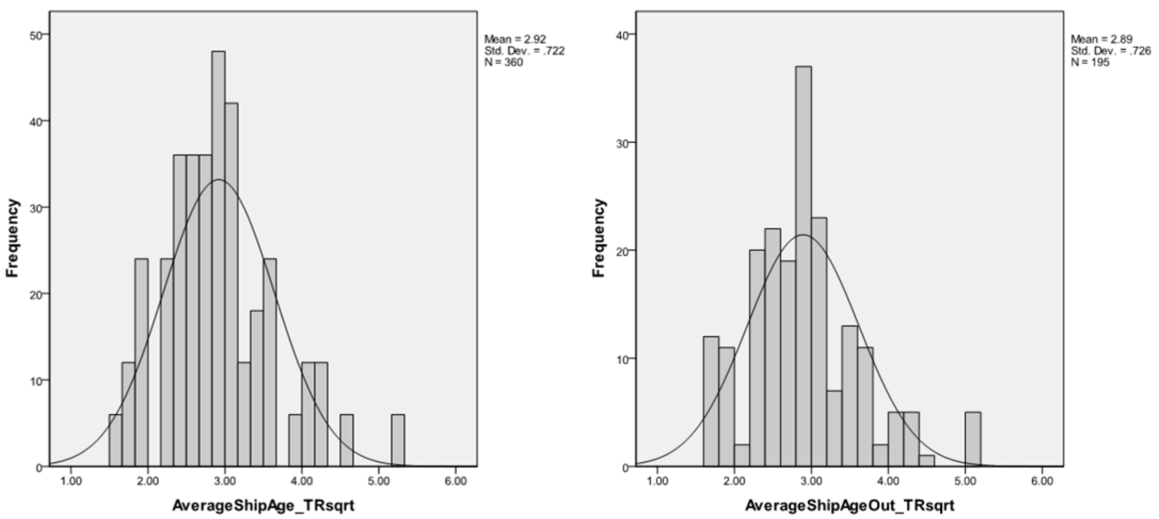


Figure B-86. Firm average ship age (years) control variable histograms after transformations (left: 360 case dataset; right: 195 case dataset)

Table B-55. Statistical assessment of normality - Firm average ship age (years)

	Original distributions		Transformed distributions	
Normality assessment tests	360 case dataset	195 case dataset	360 case dataset	195 case dataset
Kolmogorov-Smirnov statistic (sig.)	.000	.000	.000	.000
Shapiro Wilk statistic (sig.)	.000	.000	.000	.000

Reiterative visual inspections argue for acceptable levels of normality in the transformed variables. The proposition, however, is not supported by either the K-S or S-W relevant statistics tests.

B.3 Logistic regression model variable specifics (imputed dataset)

Control logistic regression Model 1 (imputed dataset)

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
a	CompanySizeShipDWT_TRlog10	-.066	.165	.161	1	.688	.936	.677	1.294
	Constant	.562	.990	.323	1	.570	1.754		

Variable(s) entered on step 1: CompanySizeShipDWT_TRlog10.

Control logistic regression Model 2 (imputed dataset)

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
a	CompanyAge_TRsqrt	.004	.042	.010	1	.922	1.004	.925	1.090
	Constant	.142	.273	.272	1	.602	1.153		

Variable(s) entered on step 1: CompanyAge_TRsqrt.

Control logistic regression Model 3 (imputed dataset)

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
a	AverageShipSize_TRsqrt	-.001	.001	.797	1	.372	.999	.996	1.001
	Constant	.466	.352	1.757	1	.185	1.594		

Variable(s) entered on step 1: AverageShipSize_TRsqrt.

Efficiency-based logistic regression Model 1 (imputed dataset)

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
a	BehUncerSuppUnreliability	.046	.096	.232	1	.630	1.047	.867	1.265
	Constant	.050	.264	.037	1	.848	1.052		

Variable(s) entered on step 1: BehUncerSuppUnreliability.

Efficiency-based logistic regression Model 2 (imputed dataset)

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
a	PrinHumAssetSpecificity_TRsqrt	.219	.266	.680	1	.410	1.245	.739	2.097
	PrinPhysAssetSpecificity_TRsqrt	-.391	.292	1.797	1	.180	.676	.382	1.198
	PrinDedAssetSpecificity_TRsqrt	-.063	.264	.057	1	.811	.939	.560	1.574
	PrinProcAssetSpecificity_TRsqrt	.553	.326	2.887	1	.089	1.739	.919	3.292
	PrinTemporalSpecificity_TRsqrtRflct	.388	.182	4.563	1	.033	1.474	1.033	2.104
	Constant	-.899	.390	5.323	1	.021	.407		

Variable(s) entered on step 1: PrinHumAssetSpecificity_TRsqrt, PrinPhysAssetSpecificity_TRsqrt, PrinDedAssetSpecificity_TRsqrt, PrinProcAssetSpecificity_TRsqrt, PrinTemporalSpecificity_TRsqrtRflct.

Efficiency-based logistic regression Model 3 (imputed dataset)

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
a	PrinHumAssetSpecificity_TRsqrt	.215	.271	.630	1	.427	1.240	.729	2.108
	PrinPhysAssetSpecificity_TRsqrt	-.391	.292	1.795	1	.180	.676	.382	1.199
	PrinDedAssetSpecificity_TRsqrt	-.064	.267	.058	1	.809	.938	.556	1.582
	PrinProcAssetSpecificity_TRsqrt	.553	.326	2.867	1	.090	1.738	.917	3.296
	PrinTemporalSpecificity_TRsqrtRflct	.379	.211	3.229	1	.072	1.461	.966	2.209
	PrinBrandCapExposure_TRsqrtRflct	.018	.208	.007	1	.932	1.018	.677	1.531
	PrinPropInfoExposure_TRsqrt	.010	.218	.002	1	.962	1.010	.659	1.549
	Constant	-.920	.457	4.053	1	.044	.398		

Variable(s) entered on step 1: PrinBrandCapExposure_TRsqrtRflct, PrinPropInfoExposure_TRsqrt.

Efficiency-based logistic regression Model 4 (imputed dataset)

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
a	PrinHumAssetSpecificity_TRsqrt	.273	.277	.976	1	.323	1.314	.764	2.260
	PrinPhysAssetSpecificity_TRsqrt	-.532	.309	2.965	1	.085	.587	.320	1.076
	PrinDedAssetSpecificity_TRsqrt	-.012	.273	.002	1	.965	.988	.579	1.686
	PrinProcAssetSpecificity_TRsqrt	.566	.341	2.761	1	.097	1.761	.903	3.433
	PrinTemporalSpecificity_TRsqrtRflct	.369	.192	3.701	1	.054	1.447	.993	2.108
	AgenHumAssetSpecificity	-.032	.094	.117	1	.732	.968	.806	1.163
	AgenPhysAssetSpecificity	.182	.120	2.287	1	.130	1.199	.948	1.518
	AgenDedAssetSpecificity	-.313	.124	6.340	1	.012	.731	.573	.933
	AgenProcAssetSpecificity	.083	.131	.399	1	.528	1.086	.841	1.403
	AgenTemporalSpecificity	.048	.058	.690	1	.406	1.049	.937	1.176
	Constant	-.710	.463	2.356	1	.125	.491		

a. Variable(s) entered on step 1: AgenHumAssetSpecificity, AgenPhysAssetSpecificity, AgenDedAssetSpecificity, AgenProcAssetSpecificity, AgenTemporalSpecificity.

Efficiency-based logistic regression Model 5 (imputed dataset)

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
a	PrinHumAssetSpecificity_TRsqrt	.119	.273	.188	1	.664	1.126	.659	1.924
	PrinPhysAssetSpecificity_TRsqrt	-.405	.297	1.861	1	.173	.667	.373	1.193
	PrinDedAssetSpecificity_TRsqrt	-.101	.268	.144	1	.705	.904	.535	1.526
	PrinProcAssetSpecificity_TRsqrt	.591	.330	3.204	1	.073	1.806	.945	3.450
	PrinTemporalSpecificity_TRsqrtRflct	.431	.185	5.446	1	.020	1.539	1.072	2.212
	AgenBrandCapExposure	.111	.079	1.992	1	.158	1.118	.958	1.305
	AgenPropInfoExposure_TRsqrt	.436	.236	3.414	1	.065	1.547	.974	2.457
	Constant	-1.855	.561	10.930	1	.001	.156		

a. Variable(s) entered on step 1: AgenBrandCapExposure, AgenPropInfoExposure_TRsqrt.

Efficiency-based logistic regression Model 6 (imputed dataset)

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
a	PrinHumAssetSpecificity_TRsqrt	.126	.283	.200	1	.655	1.135	.652	1.975
	PrinPhysAssetSpecificity_TRsqrt	-.452	.305	2.195	1	.138	.636	.350	1.157
	PrinDedAssetSpecificity_TRsqrt	-.126	.274	.211	1	.646	.882	.515	1.509
	PrinProcAssetSpecificity_TRsqrt	.562	.338	2.770	1	.096	1.755	.905	3.402
	PrinTemporalSpecificity_TRsqrtRflct	.132	.201	.434	1	.510	1.141	.770	1.692
	AgenBrandCapExposure	.089	.082	1.201	1	.273	1.094	.932	1.283
	AgenPropInfoExposure_TRsqrt	.484	.245	3.909	1	.048	1.623	1.004	2.623
	VolUncerPredictDemand	.339	.075	20.422	1	.000	1.403	1.211	1.625
	Constant	-2.188	.583	14.114	1	.000	.112		

a. Variable(s) entered on step 1: VolUncerPredictDemand.

Efficiency-based logistic regression Model 7 (imputed dataset)

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
a	PrinHumAssetSpecificity_TRsqrt	.043	.288	.022	1	.882	1.044	.594	1.835
	PrinPhysAssetSpecificity_TRsqrt	-.448	.307	2.137	1	.144	.639	.350	1.165
	PrinDedAssetSpecificity_TRsqrt	-.120	.276	.190	1	.663	.887	.516	1.522
	PrinProcAssetSpecificity_TRsqrt	.582	.342	2.898	1	.089	1.789	.916	3.494
	PrinTemporalSpecificity_TRsqrtRflct	.074	.204	.131	1	.718	1.077	.722	1.606
	AgenBrandCapExposure	.063	.083	.566	1	.452	1.065	.904	1.253
	AgenPropInfoExposure_TRsqrt	.476	.247	3.725	1	.054	1.610	.993	2.611
	VolUncerPredictDemand	.337	.075	20.159	1	.000	1.401	1.209	1.624
	TechnologicalUncertainty_TRsqrt	.258	.132	3.806	1	.051	1.294	.999	1.676
	Constant	-2.702	.650	17.279	1	.000	.067		

a. Variable(s) entered on step 1: TechnologicalUncertainty_TRsqrt.

Efficiency-based logistic regression Model 8 (imputed dataset)

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
a	PrinHumAssetSpecificity_TRsqrt	.018	.288	.004	1	.949	1.018	.579	1.792
	PrinPhysAssetSpecificity_TRsqrt	-.420	.308	1.862	1	.172	.657	.360	1.201
	PrinDedAssetSpecificity_TRsqrt	-.186	.283	.434	1	.510	.830	.476	1.446
	PrinProcAssetSpecificity_TRsqrt	.590	.342	2.977	1	.084	1.804	.923	3.526
	PrinTemporalSpecificity_TRsqrtRflct	.061	.205	.089	1	.765	1.063	.712	1.587
	AgenBrandCapExposure	.061	.083	.531	1	.466	1.063	.902	1.252
	AgenPropInfoExposure_TRsqrt	.487	.247	3.892	1	.049	1.628	1.003	2.641
	VolUncerPredictDemand	.303	.081	13.784	1	.000	1.353	1.154	1.588
	TechnologicalUncertainty_TRsqrt	.244	.133	3.354	1	.067	1.276	.983	1.657
	ValueAssessPriceTasksEase	-.100	.093	1.152	1	.283	.905	.754	1.086
	Constant	-2.098	.857	5.992	1	.014	.123		

Variable(s) entered on step 1: ValueAssessPriceTasksEase.

Efficiency-based logistic regression Model 9 (imputed dataset)

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
a	PrinHumAssetSpecificity_TRsqrt	-.018	.294	.004	1	.952	.982	.552	1.748
	PrinPhysAssetSpecificity_TRsqrt	-.383	.308	1.550	1	.213	.682	.373	1.246
	PrinDedAssetSpecificity_TRsqrt	-.275	.292	.892	1	.345	.759	.429	1.345
	PrinProcAssetSpecificity_TRsqrt	.508	.344	2.176	1	.140	1.661	.846	3.261
	PrinTemporalSpecificity_TRsqrtRflct	.036	.205	.030	1	.862	1.036	.693	1.549
	AgenBrandCapExposure	.064	.084	.577	1	.448	1.066	.904	1.256
	AgenPropInfoExposure_TRsqrt	.359	.254	1.995	1	.158	1.432	.870	2.355
	VolUncerPredictDemand	.340	.076	20.135	1	.000	1.404	1.211	1.629
	TechnologicalUncertainty_TRsqrt	.220	.134	2.693	1	.101	1.246	.958	1.619
	ContrAssessDeterSuppPerforEase	-.206	.101	4.119	1	.042	.814	.668	.993
	Constant	-1.093	1.019	1.149	1	.284	.335		

Variable(s) entered on step 1: ContrAssessDeterSuppPerforEase.

Efficiency-based logistic regression Model 10a (imputed dataset)

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
a	PrinHumAssetSpecificity_TRsqrt	-.074	.300	.060	1	.806	.929	.516	1.674
	PrinPhysAssetSpecificity_TRsqrt	-.416	.310	1.794	1	.180	.660	.359	1.212
	PrinDedAssetSpecificity_TRsqrt	-.308	.296	1.086	1	.297	.735	.412	1.312
	PrinProcAssetSpecificity_TRsqrt	.603	.351	2.951	1	.086	1.827	.919	3.635
	PrinTemporalSpecificity_TRsqrtRflct	.070	.206	.115	1	.734	1.072	.716	1.607
	AgenBrandCapExposure	.037	.085	.188	1	.665	1.038	.878	1.227
	AgenPropInfoExposure_TRsqrt	.358	.256	1.956	1	.162	1.431	.866	2.365
	VolUncerPredictDemand	.348	.077	20.539	1	.000	1.416	1.218	1.647
	TechnologicalUncertainty_TRsqrt	.243	.136	3.191	1	.074	1.275	.977	1.665
	ContrAssessDeterSuppPerforEase	-.202	.103	3.869	1	.049	.817	.668	.999
	TransactionFrequency	-.130	.064	4.152	1	.042	.878	.775	.995
	Constant	-.606	1.052	.332	1	.564	.545		

Variable(s) entered on step 1: TransactionFrequency.

Efficiency-based logistic regression Model 10b (imputed dataset)

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
a	PrinHumAssetSpecificity_TRsqrt	-.017	.294	.003	1	.954	.983	.552	1.750
	PrinPhysAssetSpecificity_TRsqrt	-.476	.309	2.376	1	.123	.621	.339	1.138
	PrinDedAssetSpecificity_TRsqrt	-.156	.280	.310	1	.578	.856	.495	1.481
	PrinProcAssetSpecificity_TRsqrt	.674	.348	3.758	1	.053	1.962	.993	3.879
	PrinTemporalSpecificity_TRsqrtRflct	.112	.205	.296	1	.586	1.118	.748	1.671
	AgenBrandCapExposure	.034	.085	.160	1	.689	1.035	.876	1.222
	AgenPropInfoExposure_TRsqrt	.471	.249	3.568	1	.059	1.602	.982	2.611
	VolUncerPredictDemand	.345	.076	20.517	1	.000	1.412	1.216	1.640
	TechnologicalUncertainty_TRsqrt	.282	.134	4.408	1	.036	1.326	1.019	1.725
	TransactionFrequency	-.133	.063	4.397	1	.036	.876	.774	.991
	Constant	-2.176	.688	10.004	1	.002	.113		

Variable(s) entered on step 1: TransactionFrequency.

Dependency-based logistic regression Model 1 (imputed dataset)

Variables in the Equation

	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
a PrinDependencePotential_TRlog10	.062	.169	.135	1	.714	1.064	.764	1.481
Constant	.189	.121	2.428	1	.119	1.207		

Variable(s) entered on step 1: PrinDependencePotential_TRlog10.

Dependency-based logistic regression Model 2 (imputed dataset)

Variables in the Equation

	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
a PrinInternPotentialDiff_TRsqrt	.481	.182	7.012	1	.008	1.618	1.133	2.311
Constant	-.546	.289	3.570	1	.059	.579		

Variable(s) entered on step 1: PrinInternPotentialDiff_TRsqrt.

Dependency-based logistic regression Model 3 (imputed dataset)

Variables in the Equation

	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
a PrinInternPotentialDiff_TRsqrt	.452	.189	5.732	1	.017	1.571	1.085	2.274
PrinCooptationPotential	.040	.069	.332	1	.565	1.041	.909	1.191
Constant	-.619	.316	3.833	1	.050	.538		

Variable(s) entered on step 1: PrinCooptationPotential.

Dependency-based logistic regression Model 4 (imputed dataset)

Variables in the Equation

	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
a PrinInternPotentialDiff_TRsqrt	.490	.183	7.201	1	.007	1.632	1.141	2.334
PrinInputToAgenBusiness_TRsqrt	-.033	.060	.305	1	.581	.968	.861	1.088
Constant	-.486	.308	2.493	1	.114	.615		

Variable(s) entered on step 1: PrinInputToAgenBusiness_TRsqrt.

Competence-based logistic regression Model 1 (imputed dataset)

Variables in the Equation

	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
a ContributionToHigherGains	.072	.034	4.590	1	.032	1.075	1.006	1.148
Constant	-.347	.261	1.758	1	.185	.707		

Variable(s) entered on step 1: ContributionToHigherGains.

Competence-based logistic regression Model 2 (imputed dataset)

Variables in the Equation

	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
a ContributionToHigherGains	.088	.037	5.586	1	.018	1.092	1.015	1.174
ContrToCostsCompeteOnCosts	-.071	.069	1.053	1	.305	.932	.814	1.067
Constant	-.200	.298	.452	1	.501	.819		

Variable(s) entered on step 1: ContrToCostsCompeteOnCosts.

Competence-based logistic regression Model 3 (imputed dataset)

Variables in the Equation

	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
a ContributionToHigherGains	.063	.048	1.739	1	.187	1.065	.970	1.171
PotentialResourceValue	.014	.053	.066	1	.798	1.014	.913	1.125
Constant	-.368	.275	1.798	1	.180	.692		

Variable(s) entered on step 1: PotentialResourceValue.

Competence-based logistic regression Model 4 (imputed dataset)

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
a	ContributionToHigherGains	.074	.035	4.556	1	.033	1.077	1.006	1.153
	ResourceScarcityRecruitDiff	.304	.071	18.526	1	.000	1.355	1.180	1.556
	Constant	-1.306	.352	13.751	1	.000	.271		

Variable(s) entered on step 1: ResourceScarcityRecruitDiff.

Competence-based logistic regression Model 5 (imputed dataset)

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
a	ContributionToHigherGains	.079	.037	4.630	1	.031	1.082	1.007	1.163
	ResourceScarcityRecruitDiff	.272	.075	12.992	1	.000	1.313	1.132	1.522
	IntrafirmCausalAmbiguity	.144	.047	9.225	1	.002	1.155	1.052	1.268
	ResourceInterconnected	.068	.082	.685	1	.408	1.070	.911	1.256
	ResourceSocialComplexity_TRsqrt	.288	.137	4.422	1	.035	1.334	1.020	1.745
	Constant	-3.312	.714	21.546	1	.000	.036		

Variable(s) entered on step 1: IntrafirmCausalAmbiguity, ResourceInterconnected, ResourceSocialComplexity_TRsqrt.

Identity-based logistic regression Model 1 (imputed dataset)

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
a	ResourceIdentityCoherence	-.111	.098	1.297	1	.255	.895	.738	1.084
	Constant	.729	.505	2.082	1	.149	2.072		

Variable(s) entered on step 1: ResourceIdentityCoherence.

Identity-based logistic regression Model 2 (imputed dataset)

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
a	SourcingInfluenceInstitutional	-.066	.093	.498	1	.480	.937	.781	1.123
	Constant	.505	.491	1.059	1	.303	1.657		

Variable(s) entered on step 1: SourcingInfluenceInstitutional.

Identity-based logistic regression Model 3 (imputed dataset)

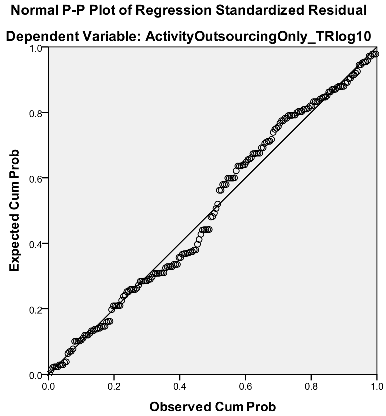
Variables in the Equation

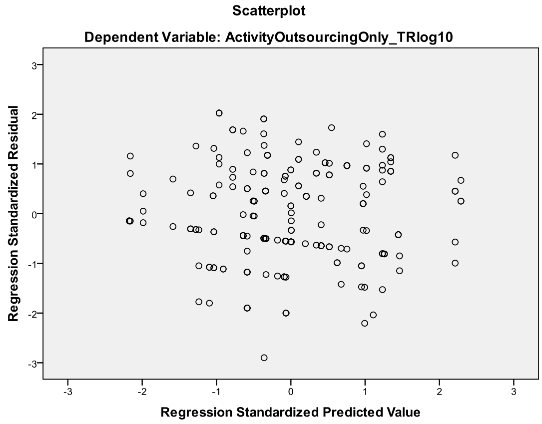
		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
a	SourcingInfluenceIndustrial	-.022	.071	.094	1	.760	.978	.851	1.125
	Constant	.241	.265	.828	1	.363	1.273		

Variable(s) entered on step 1: SourcingInfluenceIndustrial.

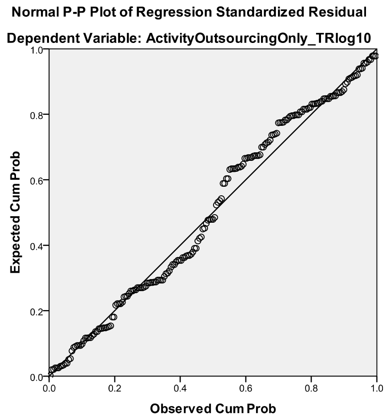
B.4 Multiple regression model residuals scatterplots (original dataset)

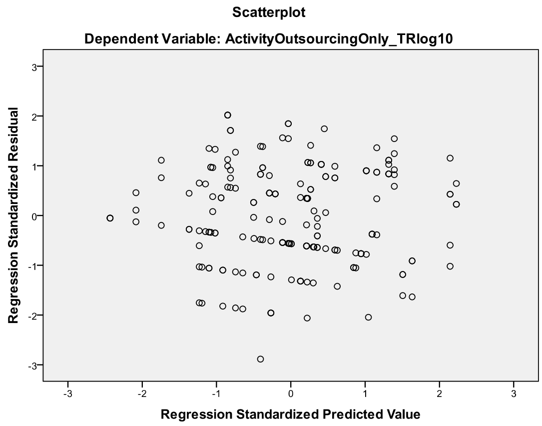
Control multiple regression Model 1 (original dataset)



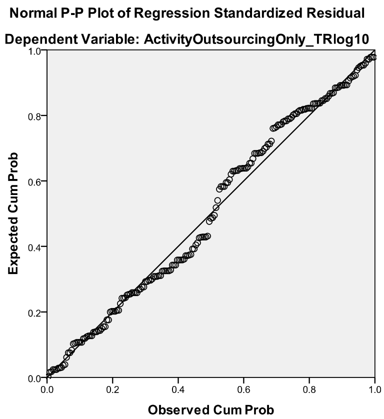


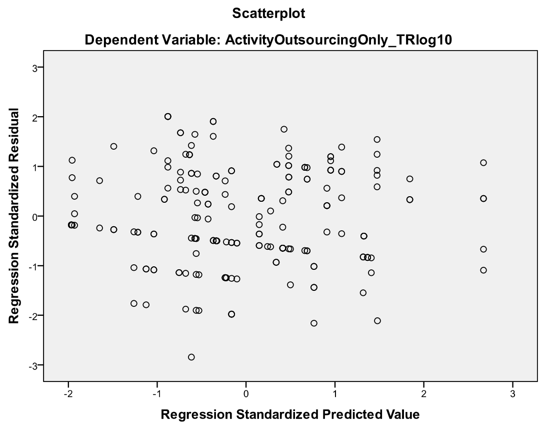
Control multiple regression Model 2 (original dataset)



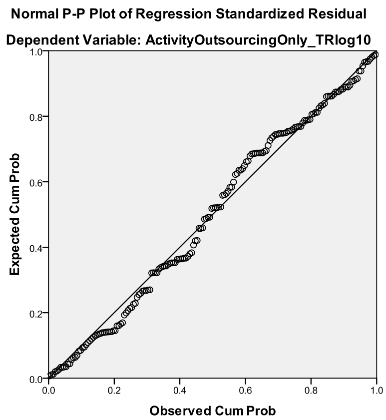


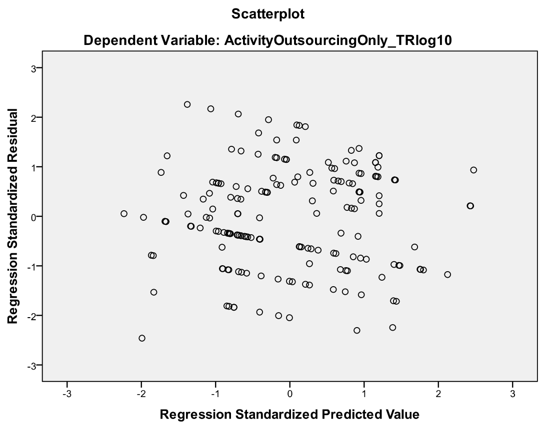
Control multiple regression Model 3 (original dataset)



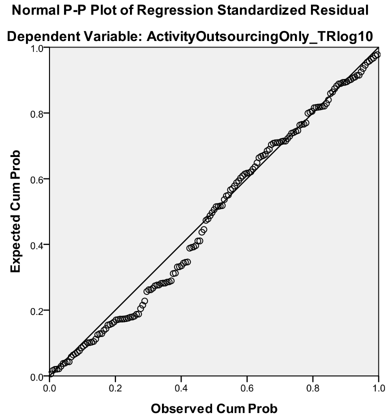


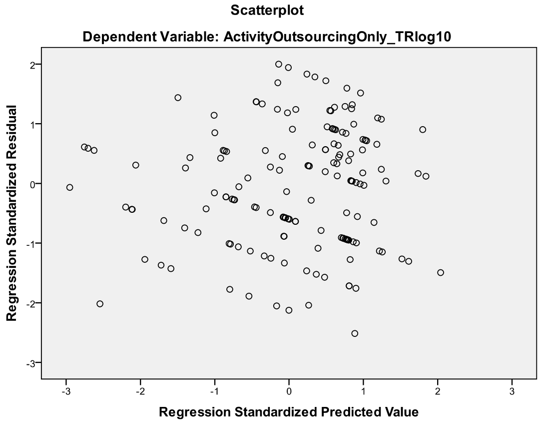
Efficiency-based multiple regression Model 1 (original dataset)



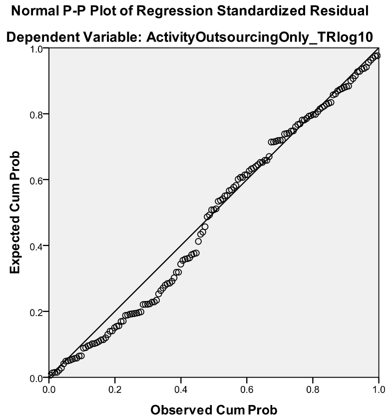


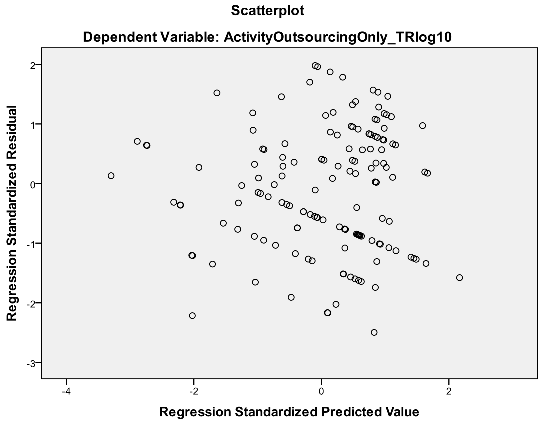
Efficiency-based multiple regression Model 2 (original dataset)



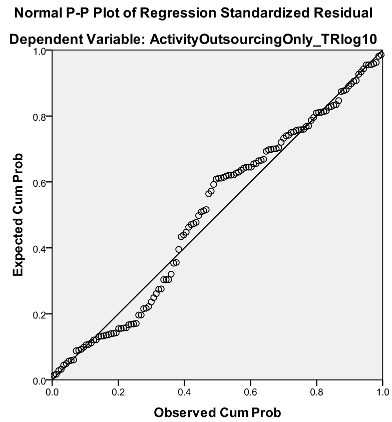


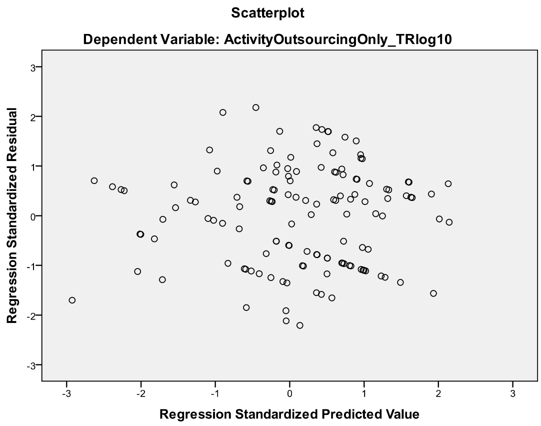
Efficiency-based multiple regression Model 3 (original dataset)



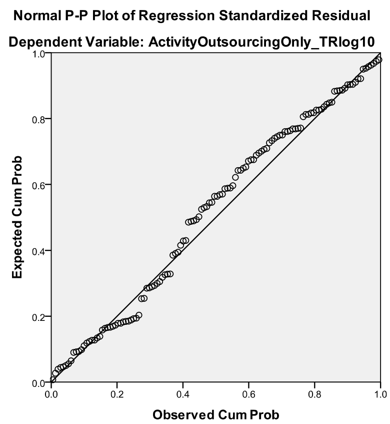


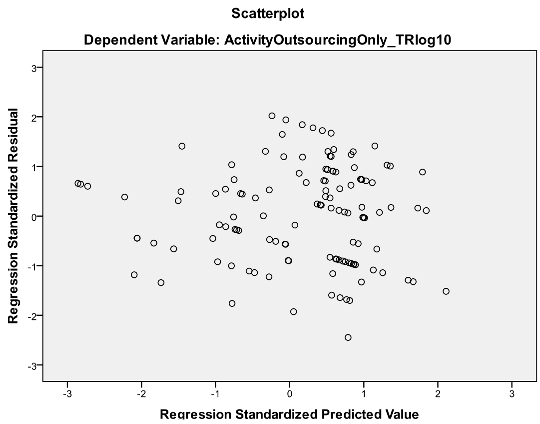
Efficiency-based multiple regression Model 4 (original dataset)



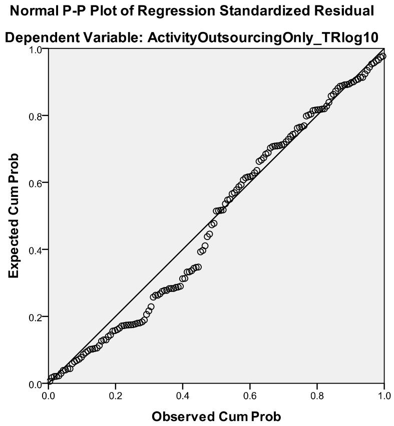


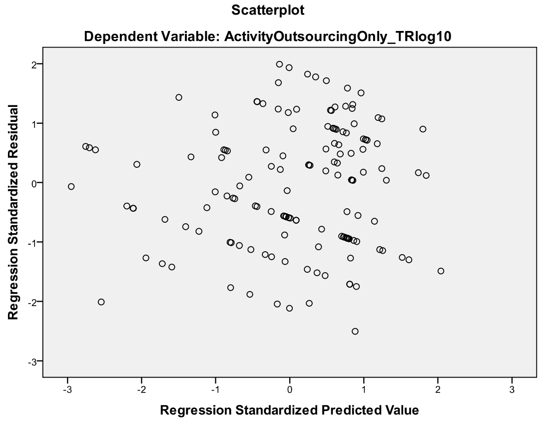
Efficiency-based multiple regression Model 5 (original dataset)



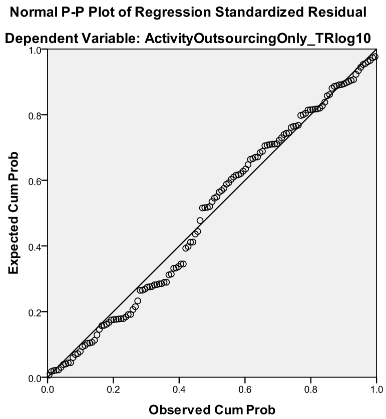


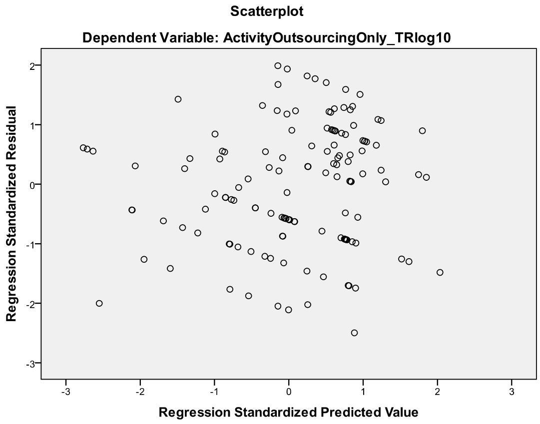
Efficiency-based multiple regression Model 6 (original dataset)



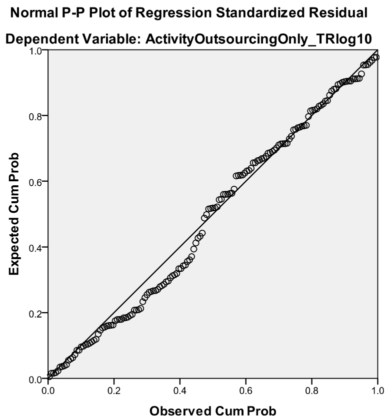


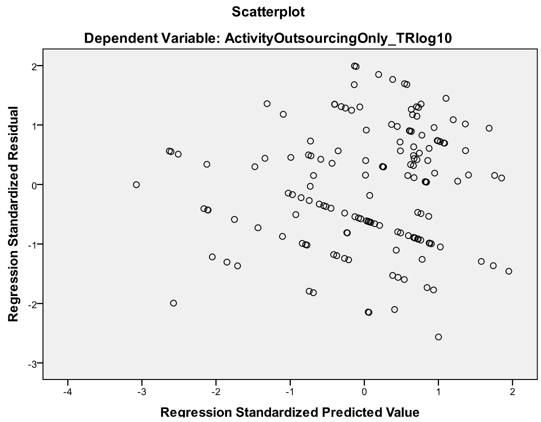
Efficiency-based multiple regression Model 7 (original dataset)



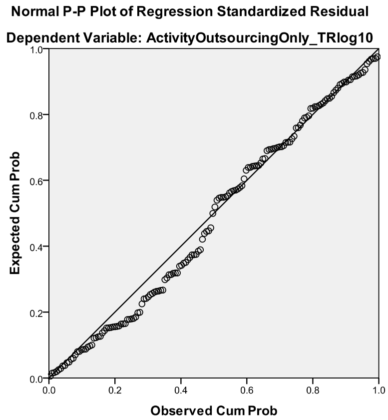


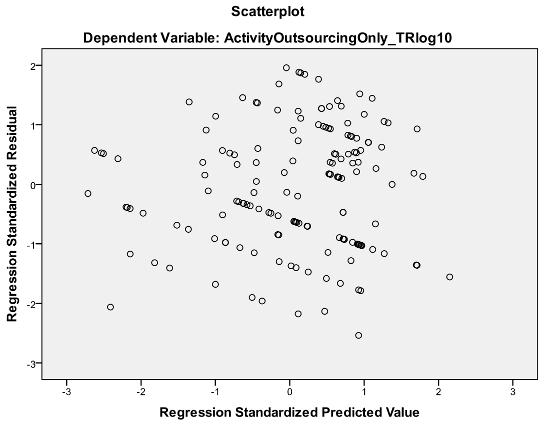
Efficiency-based multiple regression Model 8 (original dataset)



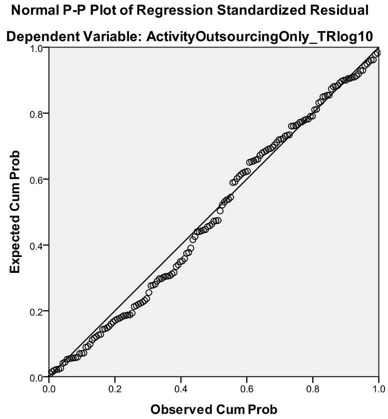


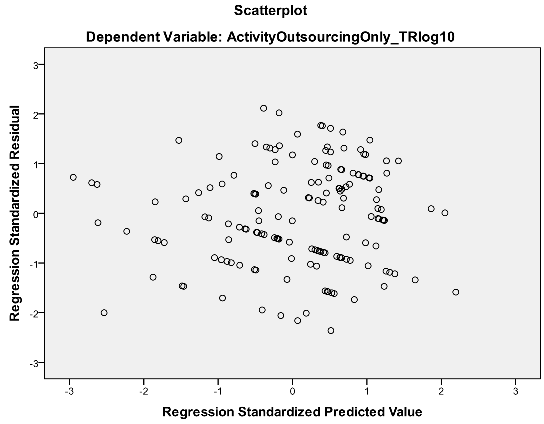
Efficiency-based multiple regression Model 9 (original dataset)



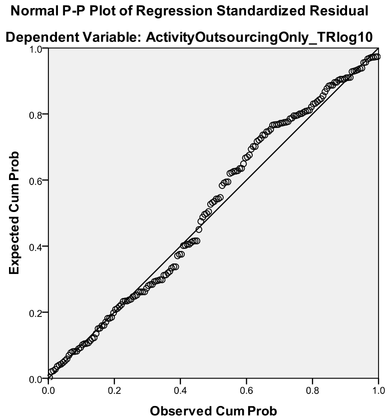


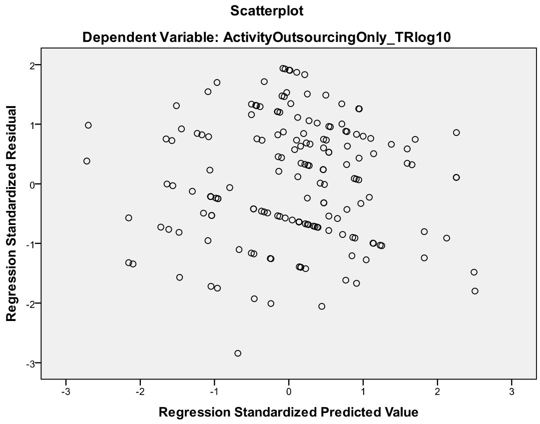
Efficiency-based multiple regression Model 10 (original dataset)



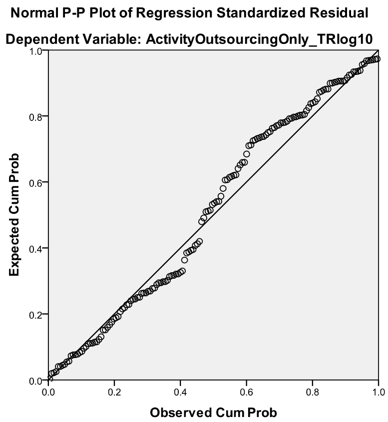


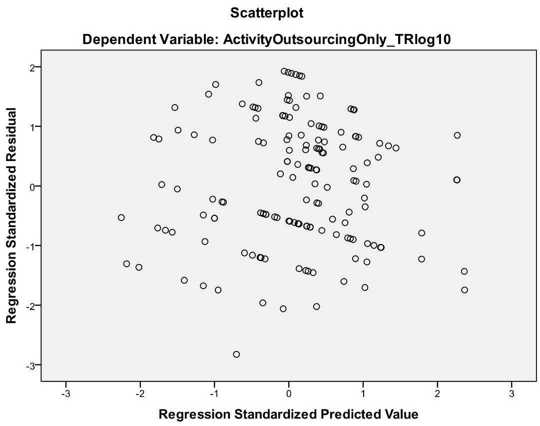
Dependency-based multiple regression Model 1 (original dataset)



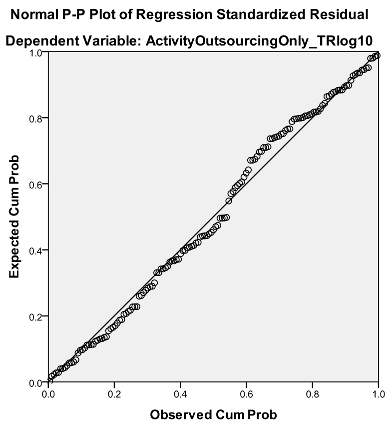


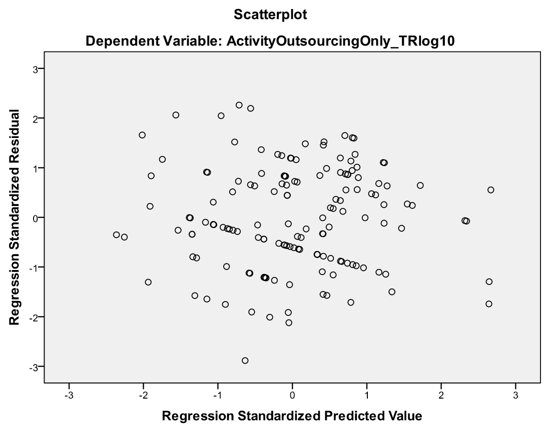
Dependency-based multiple regression Model 2 (original dataset)



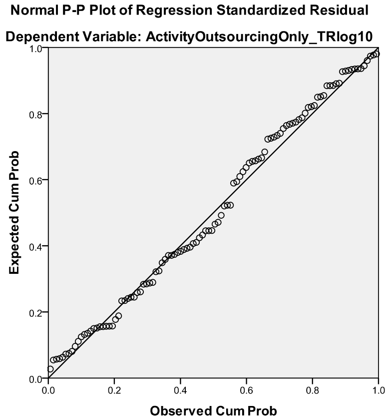


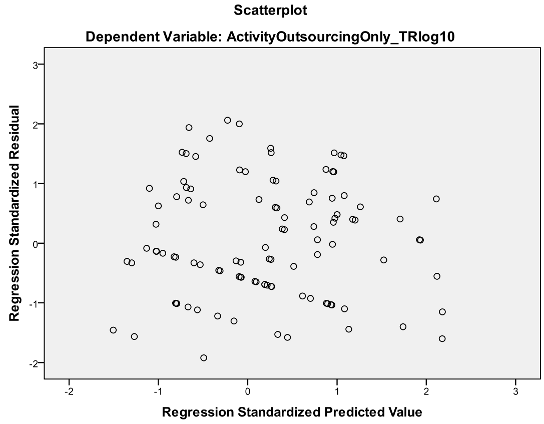
Dependency-based multiple regression Model 3 (original dataset)



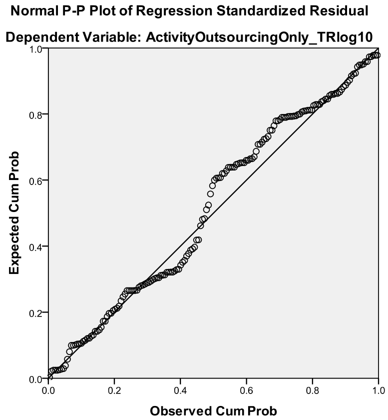


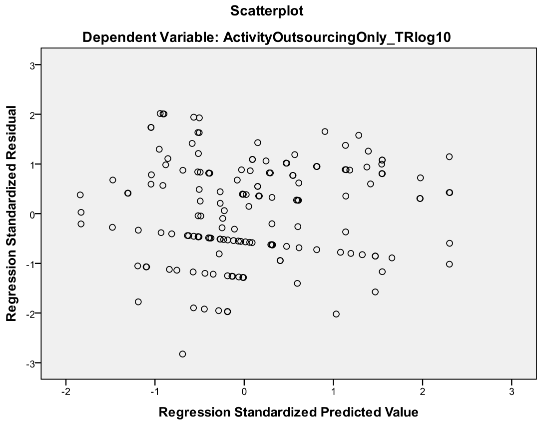
Dependency-based multiple regression Model 4 (original dataset)



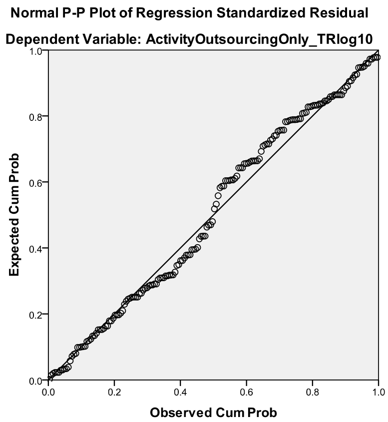


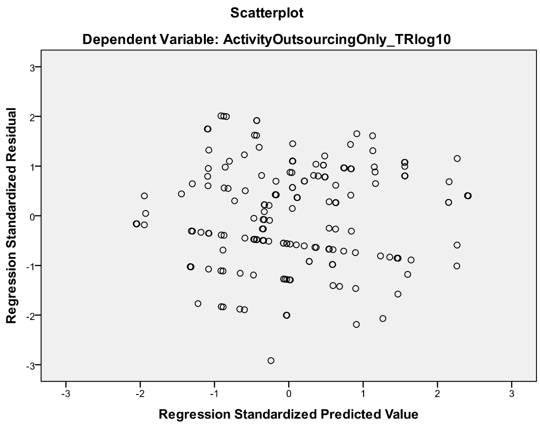
Competence-based multiple regression Model 1 (original dataset)



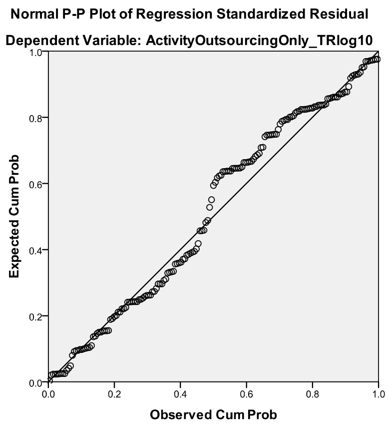


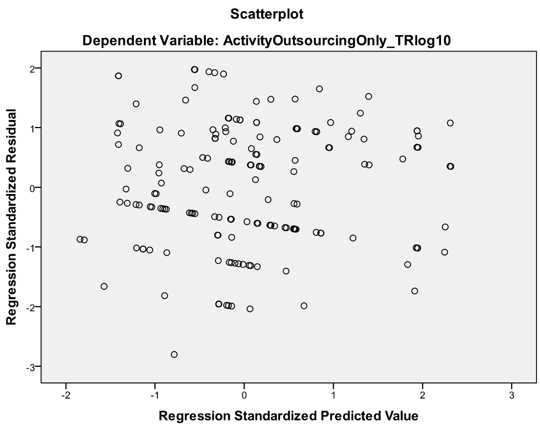
Competence-based multiple regression Model 2 (original dataset)



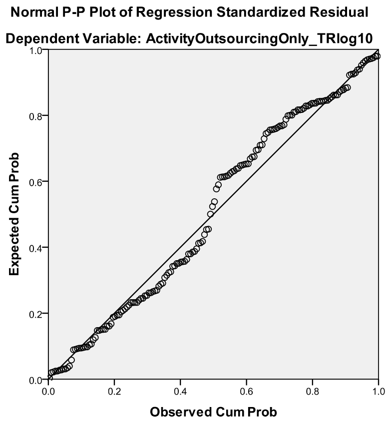


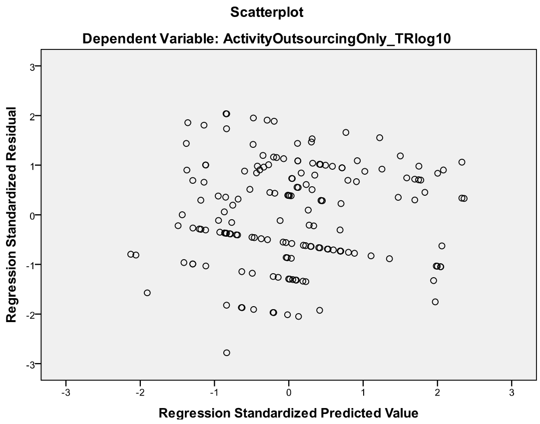
Competence-based multiple regression Model 3 (original dataset)



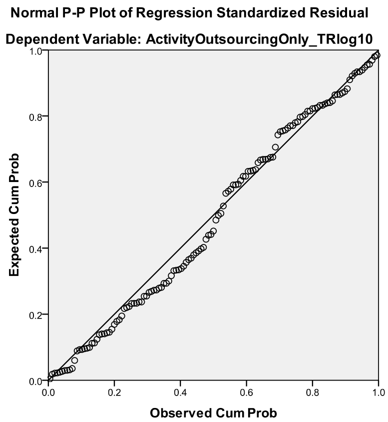


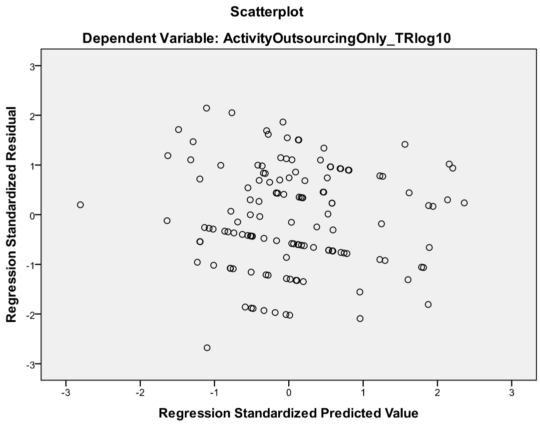
Competence-based multiple regression Model 4 (original dataset)



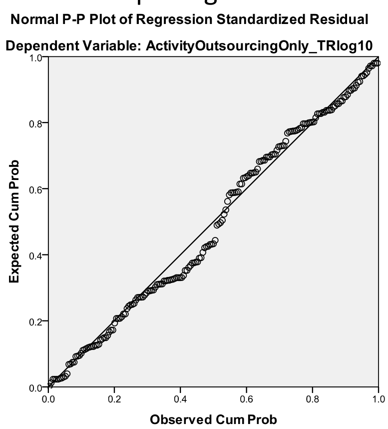


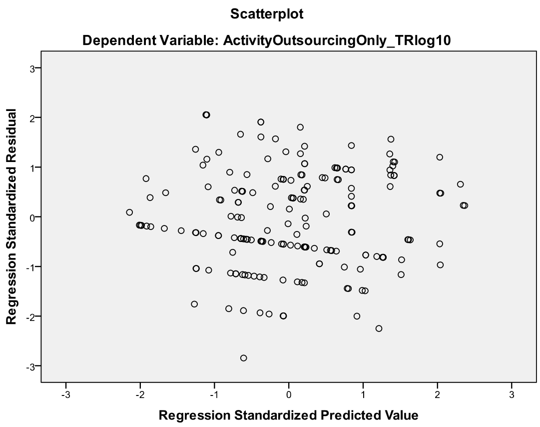
Competence-based multiple regression Model 5 (original dataset)



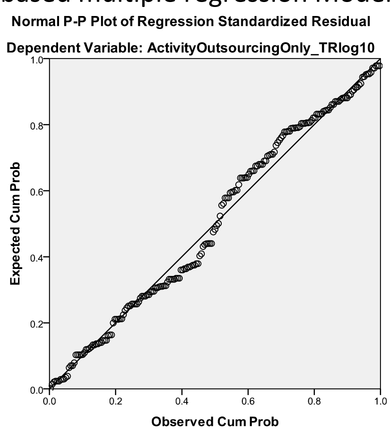


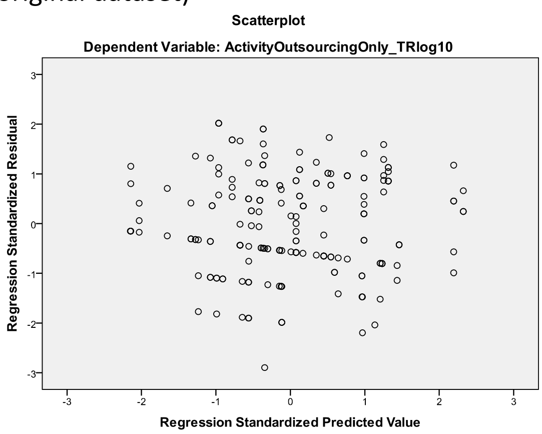
Identity-based multiple regression Model 1 (original dataset)



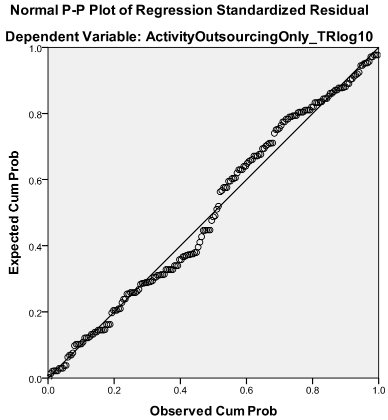


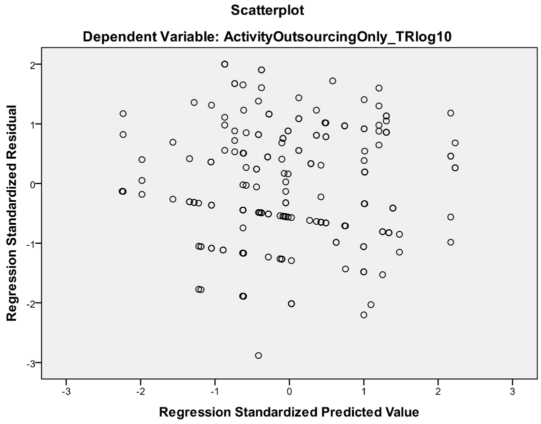
Identity-based multiple regression Model 2 (original dataset)





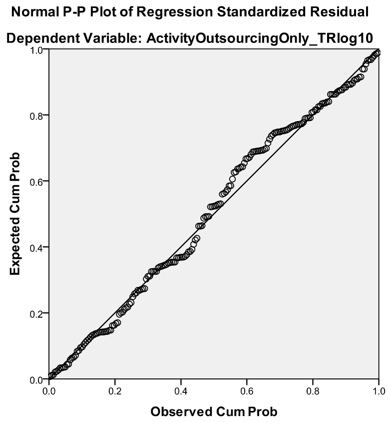
Identity-based multiple regression Model 3 (original dataset)

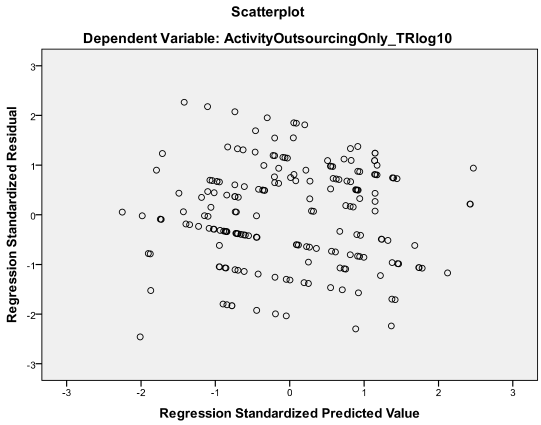




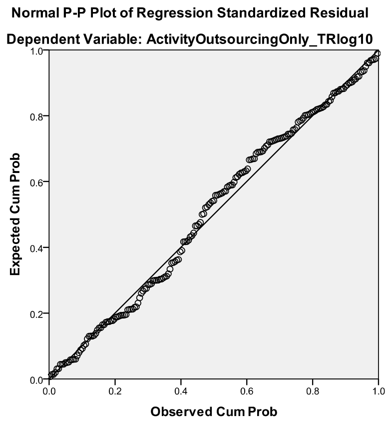
B.5 Multiple regression model residuals scatterplots (imputed dataset)

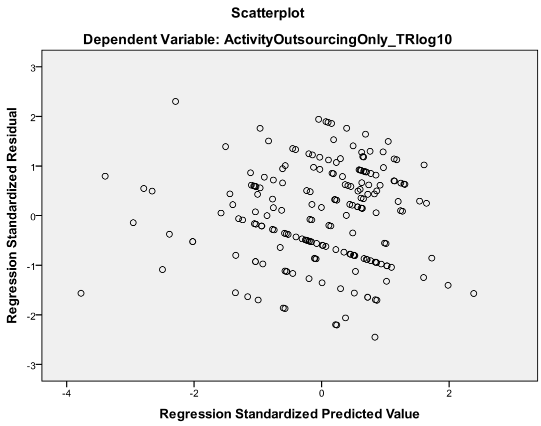
Efficiency-based multiple regression Model 1 (imputed dataset)



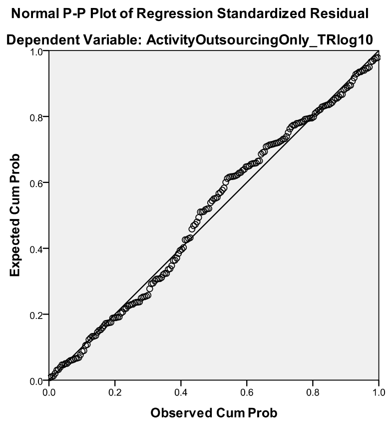


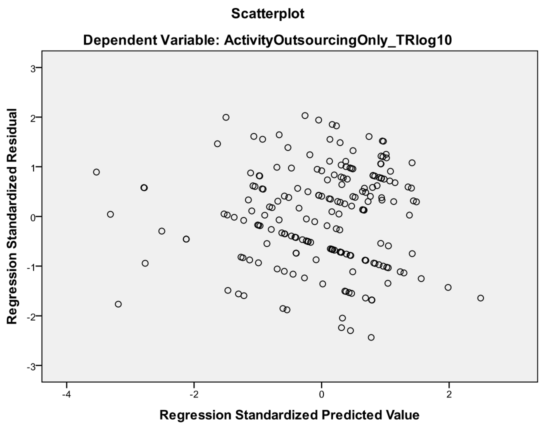
Efficiency-based multiple regression Model 2 (imputed dataset)



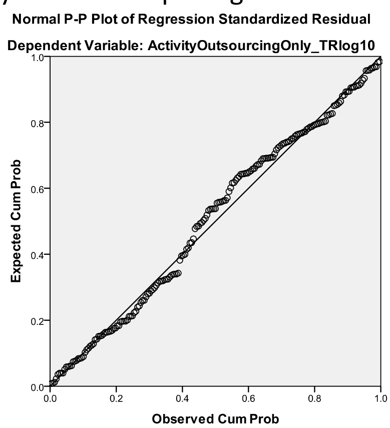


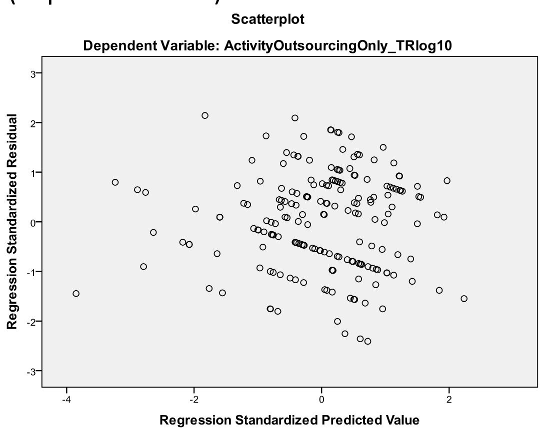
Efficiency-based multiple regression Model 3 (imputed dataset)



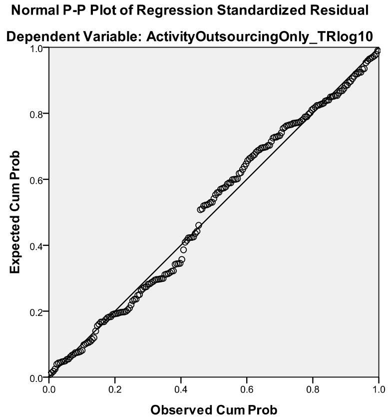


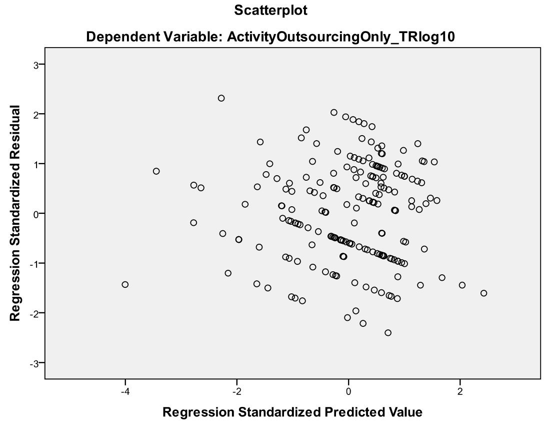
Efficiency-based multiple regression Model 4 (imputed dataset)



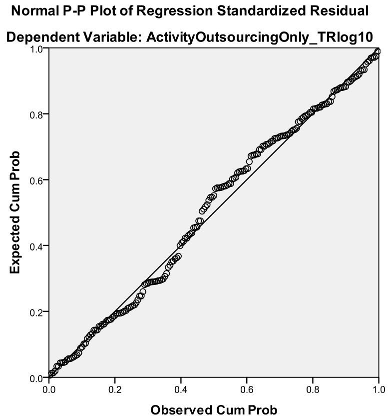


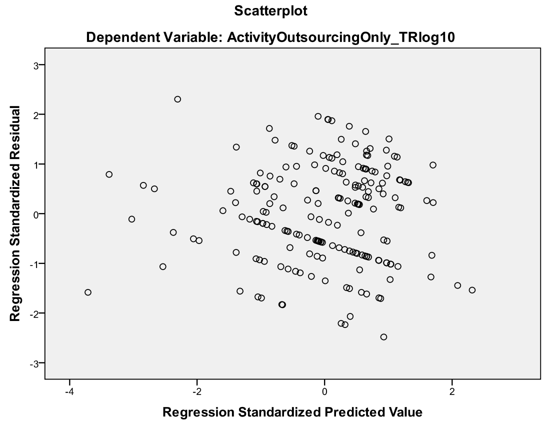
Efficiency-based multiple regression Model 5 (imputed dataset)



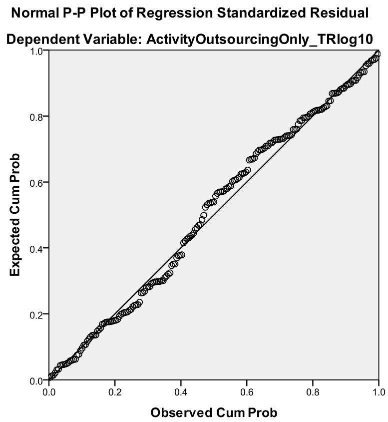


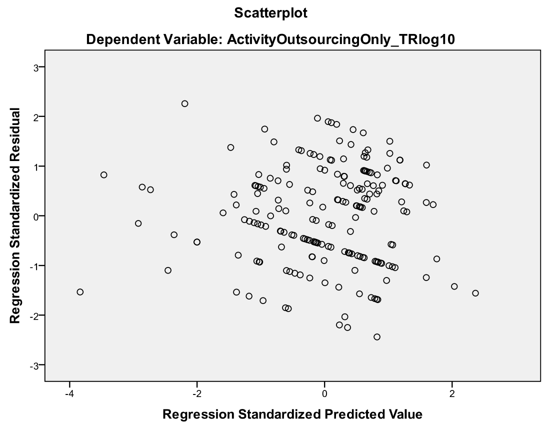
Efficiency-based multiple regression Model 6 (imputed dataset)



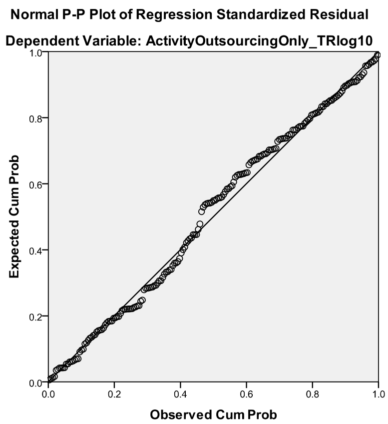


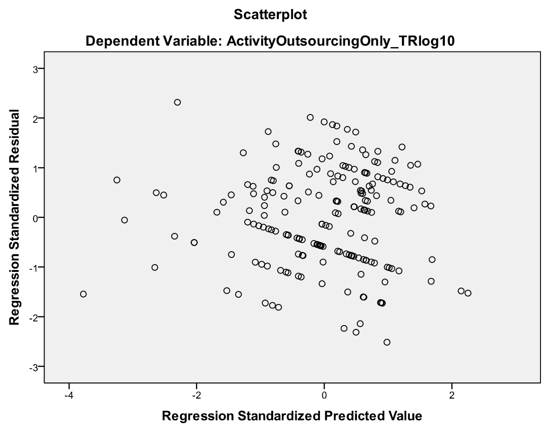
Efficiency-based multiple regression Model 7 (imputed dataset)



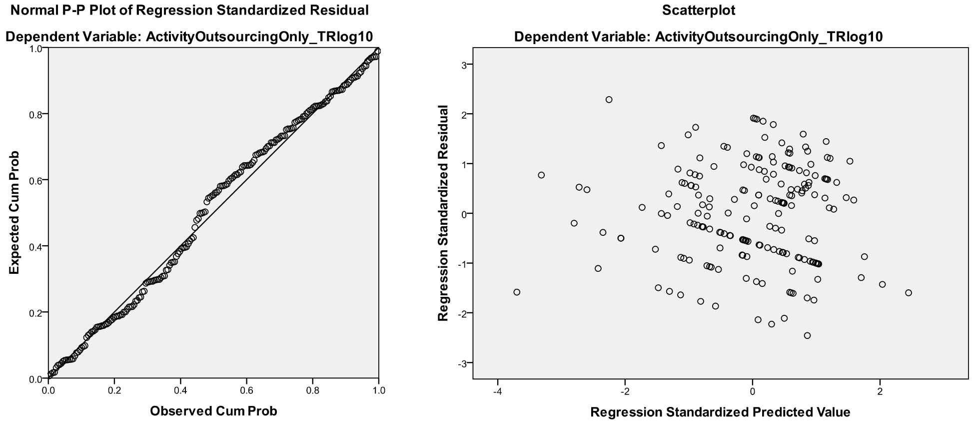


Efficiency-based multiple regression Model 8 (imputed dataset)

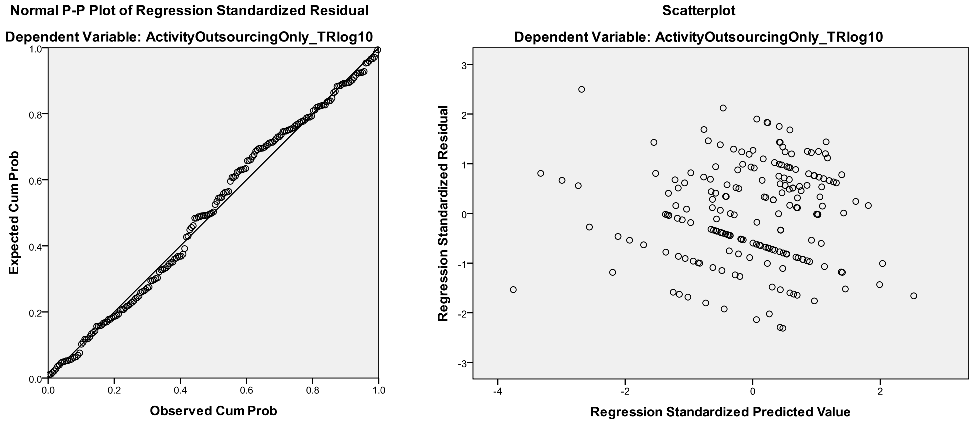




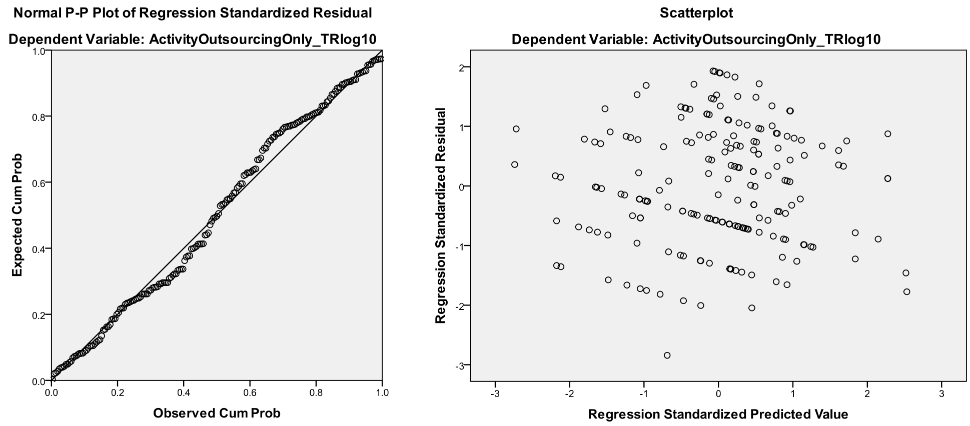
Efficiency-based multiple regression Model 9 (imputed dataset)



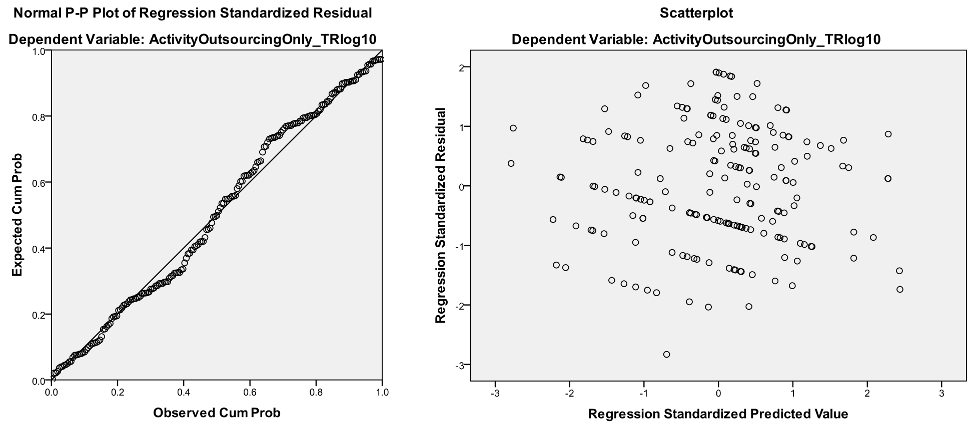
Efficiency-based multiple regression Model 10 (imputed dataset)



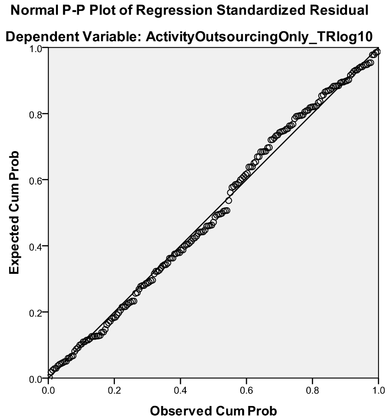
Dependency-based multiple regression Model 1 (imputed dataset)

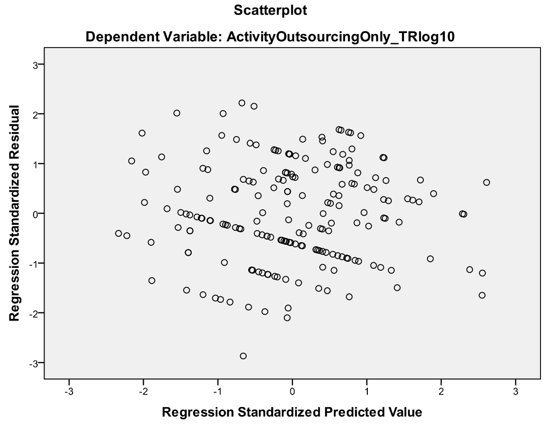


Dependency-based multiple regression Model 2 (imputed dataset)

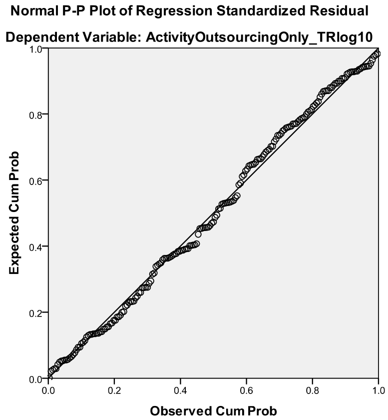


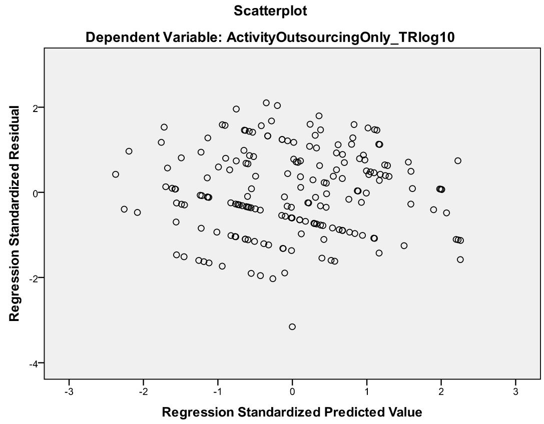
Dependency-based multiple regression Model 3 (imputed dataset)



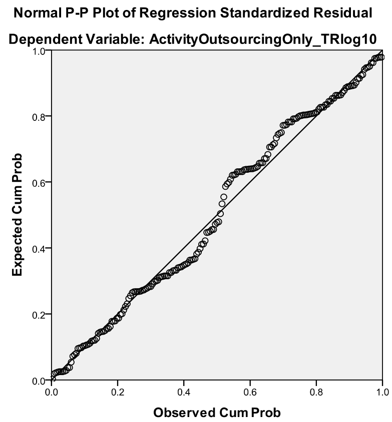


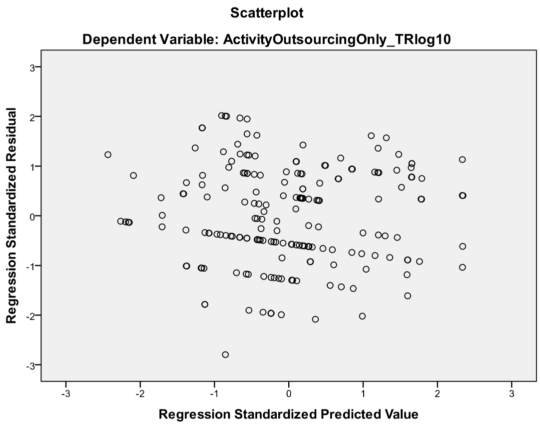
Dependency-based multiple regression Model 4 (imputed dataset)



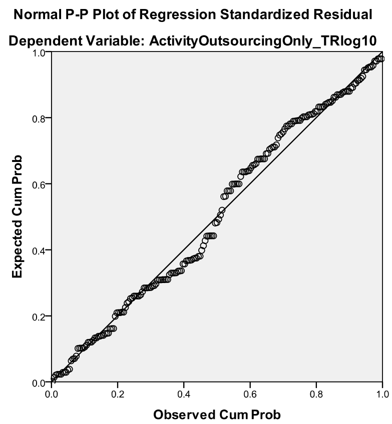


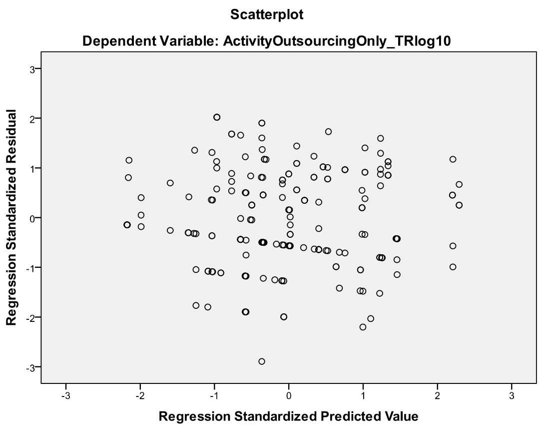
Competence-based multiple regression Model 1 (imputed dataset)



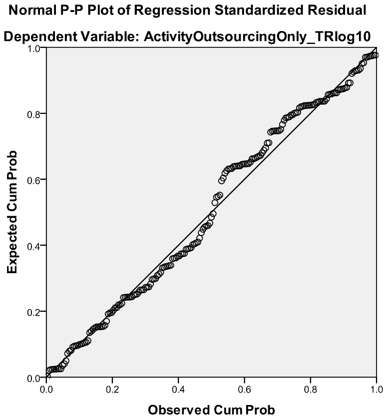


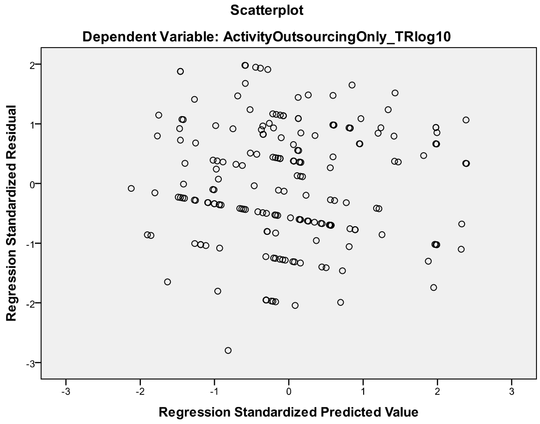
Competence-based multiple regression Model 2 (imputed dataset)



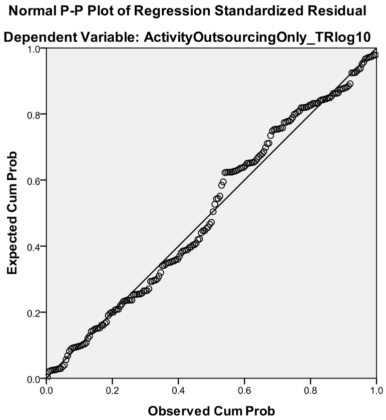


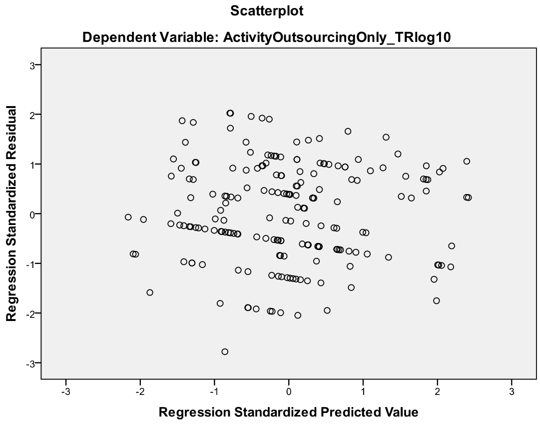
Competence-based multiple regression Model 3 (imputed dataset)



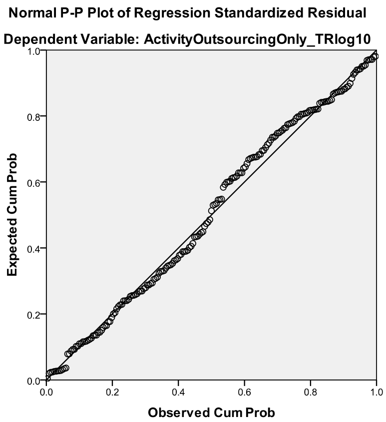


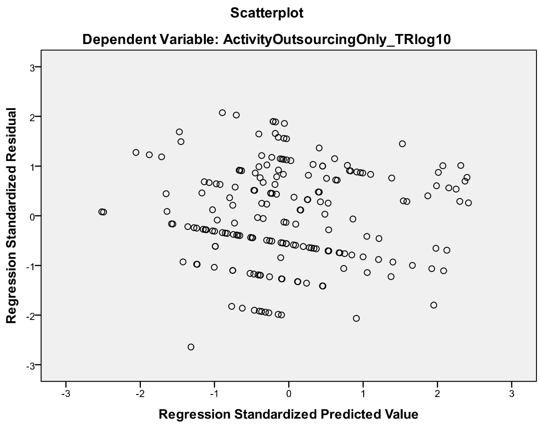
Competence-based multiple regression Model 4 (imputed dataset)



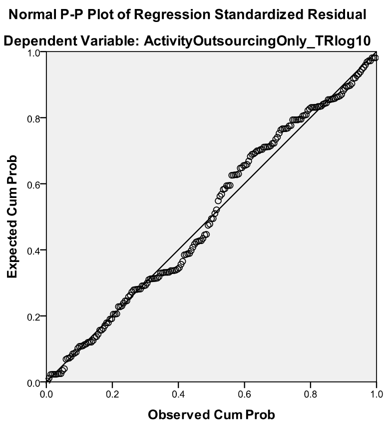


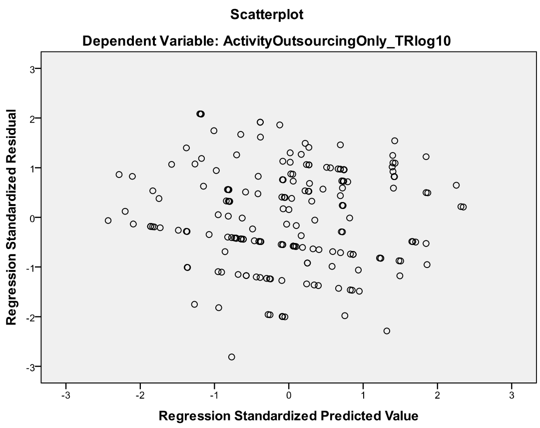
Competence-based multiple regression Model 5 (imputed dataset)



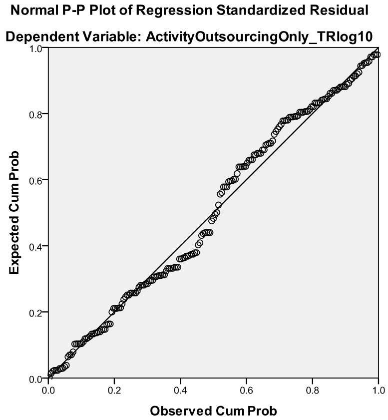


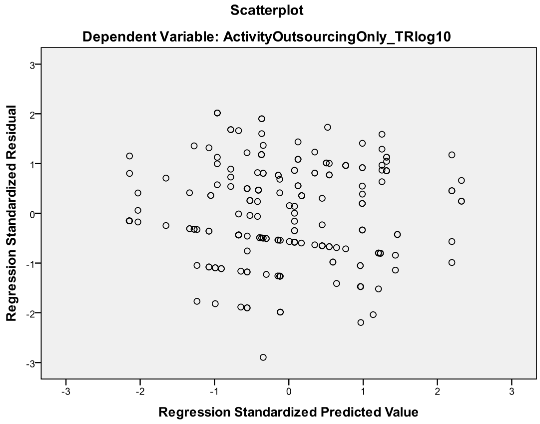
Identity-based multiple regression Model 1 (imputed dataset)





Identity-based multiple regression Model 2 (imputed dataset)





Identity-based multiple regression Model 3 (imputed dataset)